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CONTENTS:

The exhibition of signaling apparatus at the Coliseum this week gives a good idea of the remarkable development that has taken place in this department of railway engineering during the last year. The devices which are being shown exemplify many improvements in the design, use, and manufacture of signaling materials. A number of new devices are being introduced, and the makers of signals and interlocking plants are taking full advantage of the excellent opportunity afforded by this annual exhibition to show them to railway men. There is probably no line of railway work in which such marked progress has been made during the last twelve months as in signaling, and while recent developments in connection with government regulation may affect for a time the general tendency of railways to spend money for improvements, it does not seem probable that signaling will be much affected. There are two main causes for this. One is the fact that legislative bodies are showing considerable activity in the framing of compulsory safety measures, and the other is that railway managers seem at last to have come to recognize that signals will actually increase the operating capacity of a track to an extent that will more than repay the interest on the investment necessary to install them. For these reasons the exhibitions of signal appliances are proving exceedingly interesting and instructive to many officials who probably never before took occasion to examine them, and, on account of the many engineering problems involved in the recent developments and new designs, signalmen will be more interested than ever before. It is interesting to note that the committee on signaling, which was appointed some time ago by the Railway Commission of Indiana to investigate the various systems of block signaling now available, is planning to have a meeting in Chicago during this week, with a view to studying the various types of signals for steam and electric roads which will be on exhibition.

Custom permits the prefixing of the term "progress" to almost any kind of committee report, whether it really indicates progress or not. Thus there are some so-called progress reports presented at various association meetings which do not mean very much. In some cases these take the form of excuses rather than records of actual work done. It is plain to be seen, however, that there is no necessity for questioning the propriety of this term with respect to the work of the Railway Signal Association committees, for most of the reports submitted at its stated meetings indicate, not only a comprehensive grasp of the work assigned, but also substantial progress toward its completion. And yesterday's meeting was no exception in this respect, for the reports in the main show that the committees are taking hold of their respective subjects in a way that promises well for the quality of the reports representing the year's work, which will be submitted at the annual meeting next October. In view of the fact that it is only about two months since the committees were appointed, they are to be congratulated upon the excellent showing already made. The "neighborhood meetings," which were tried in 1910, and which proved very helpful, will, no doubt, be found even more profitable this year. In general, the present committees, while they realize that their predecessors have done some excellent work, seem determined, to exceed even the high mark of last year in the quality of their own reports.

The morning session of the Railway Signal Association meeting was devoted largely to a discussion of the proposed standard symbols submitted by Committee 1. The subject of standard symbols is one in which every man in the signaling profession is vitally interested, and it was only to be expected that many opinions would be expressed. It was recognized from the beginning of the committee work that the formation of a system of symbols would necessitate some arbitrary conclusions, and, as a few of the members stated, the committee several times despaired of reaching a satisfactory working basis. Then there was the question of the number of situations to be covered, which alone is a big problem, and in the minds of some has received too little attention at the hands of the committee. For example, there was a demand by some for a system of symbols that would be so complete as to tell at a glance the type of power used to actuate a signal, and many more details that would seem to be evident in the average case "from the context," i. e., fully explained by the general characteristics of the particular installation in question. Others thought that there were too many symbols in certain parts of the report. It was brought out, too, that while the symbols which shall be decided upon will be, perhaps, of more value to manufacturers than any one else, still an effort should be made to present them in such shape that they will be equally intelligible to the signalmen of all the railways interested in joint facilities. Mr. Mountain of the board of railway commissioners of Canada raised the point that there should be some provision for symbols representing changes at plants, or substitutions or alterations with which manufacturers have little or nothing to do. His comment, from the standpoint of one who has to approve or disapprove of proposed schemes, brought a third factor into the work, which probably will require more consideration than has been given to it, though a way of

distinguishing between functions that are to be taken out, to remain intact, or to be added, is found in the use of colors, as was brought out. On the whole, however, the report is a long step forward, and furnishes a basis for a system of conventional signs that will require comparatively few changes to put into good shape for adoption. This system will, of course, suffer more or less change when it is put in use by the different signal departments, but any system, no matter how much discussion and work were put on it by the committee and the association, would be subjected to such modifications.

One of the most valuable activities of the Railway Signal Association is the recent publication, in pamphlet form, of various committee reports, which are sold at a low cost to those interested.

This method of handling the reports ought to prove a good revenue producer, for some of the committees have made such thorough and exhaustive studies of the subjects assigned to them that the pamphlets containing the results of their work embody nearly all there is to be said on the matters in question. A notable instance of this is the "Index to Signaling Literature," compiled by Mr. Eck's committee on the promotion of signaling education, which is a very valuable addition to technical literature. The report of Committee X on electric signaling for electric railways, is another excellent work and one that will undoubtedly be very highly appreciated by electric railway signalmen particularly. The various specifications are also now available in a form convenient to supply the demand for them, which has grown to considerable proportions in the last few years.

At a meeting on March 19, 1911, Committee X of the Railway Signal Association made several changes in its report, and in consequence, the form in which it was presented to the association on Monday, March 20, was not the same as that in which it was published in the advance sheets. The revised portions of the report were read by Mr. Balliet, and are included in the proceedings published elsewhere. They include some important changes and make the report much more complete. The committee also added outlines for line fixtures, switch indicators, electric locks, junction terminals, lighting arresters, number plates and numbers, locks, signal lanterns and lamps, concrete and paint, and also a number of definitions involving the meaning of terms relating principally to alternating current installations on electrified lines. The committee practically completed the outline of its year's work, and probably its future labors will be mainly for the purpose of filling in this outline.

The heavy advance registration and largely increased number of early arrivals for the twelfth annual convention of the American Railway Engineering and Maintenance of Way Association, opening this morning, forecast a very profitable convention. This interest shown and the earnest and intelligent work done by the committees during the past year, indicate a state of healthy growth and activity. When one considers the amount of really constructive work which has been done by the association in its short life, he realizes the important place it occupies in the engineering—and especially in the railway engineering—field. Its scope is constantly broadening and the possibilities of study becoming greater, particularly with respect to the subjects of electricity, rail and impact tests on iron and steel structures. The investigations of these matters are but fairly begun. While much has been done in the study of economics of railway location, a very large portion of this field is still undeveloped. In fact, each year's study opens up other worlds for conquest. When busy men, such as the members of the association, voluntarily take the time, not merely to attend the conventions, but the much greater time required for committee work, the prospects are bright for a continued forward movement by the association.

President Denney's ruling limiting the discussion of Mr. McKeen's paper to the relative merits of the storage and primary batteries from an operating standpoint, was well taken, as by it he avoided what might have proved an embarrassing situation. The discussion would have resolved itself into a comparison of figures by representatives of manufacturers, and, as Mr. Denney said, it is not within the province of the association to decide such questions. His view was that the association is not in possession of the facts necessary to a determination of the matter. They are all in the hands of the supply men. Mr. Shaver's speech, published in the proceedings, was an admirable statement of the case. It is useless to compare results as between roads, or even parts of roads, as conditions are always different, and mere variations in plant are not a sufficient criterion of the variations in practice needful for the satisfactory operation of the different roads. In other words, conditions govern practice, and practices, therefore, cannot be accurately compared unless conditions are similar.

SIGNAL ASSOCIATION REPORTS.

The subjects which have occupied the attention of the various standing committees of the Railway Signal Association have become each year more nearly standardized, until now practically the only treatment some of them require consists of revising the work of previous years. Meanwhile, however, new subjects growing out of the increasing importance of signaling and its rapid extension to a greater mileage are constantly arising. When one of these has proved important enough to be handled by a special committee, the Signal Association has quickly met the situation by appointing the needed new committee.

After the 1909 annual meeting at Louisville, Ky., Committee X was appointed to report on electric signaling for electric railways, and special committees were created to study thoroughly methods of recording signal failures and the promotion of signaling education. The report of Committee X, explaining the principles of the use of alternating current on electric lines and describing a number of installations, forms an exceedingly valuable addition to the work of the association, while Mr. Eck's index to signaling literature has already become well-nigh indispensable.

Since the last annual meeting at Richmond, Va., in October, 1910, two other new committees have been appointed,—XI on the Manual, and XII on Contracts. The making of a Manual of Recommended Practice, which is to be the work of Committee XI, is decidedly worthy of the association's best efforts; and if it shall succeed in producing a Manual which shall represent accepted practice in signaling as well as the Manual of the Maintenance of Way Association represents standard engineering practice, it will indeed have done a work of which to be proud. Signaling standards are now in such shape that there is no reason why a good start cannot be made on the Manual, and substantial results obtained within a comparatively short time.

The subject of contracts, assigned to Committee XII, is a live one in signal departments. Agreements between the different roads interested in the construction, maintenance, and operation of joint interlocking plants very often are prolific sources of trouble and inconvenience, most of which would undoubtedly be removed by the adoption of a standard method of apportioning this joint expense. In cases where special contracts must be made to cover local conditions the standard form of agreement could at least be used as a basis. The work of this committee is, therefore, extremely important, and it should be given the hearty support and co-operation of every member. It is true that a few of its conclusions may of necessity be somewhat arbitrary, or at least appear so to some, but unless those who think thus are willing to give way to the majority and abide by the arrangement that shall be adopted, the troubles that make a standard form desirable will not have been overcome. The

objections that may be brought up after standard values for each function, or unit, have been agreed on are the same objections that operate against the determination of these values in the first place. In other words, they are fundamental, and if the majority agrees that they have not sufficient importance to prevent the adoption of arbitrary values they should not be brought up as arguments against the report after it is accepted as the Signal Association's standard. Therefore, every member who has an opinion on this subject of the division of expense and the proper value to be given each function, or unit, should make it known while the matter is under consideration by the committee in order that when the work is done it may stand as the association's accepted practice, and not be nullified by repetition of the very objections that may be disposed of by the committee.

PAPERS READ AT SIGNAL ASSOCIATION MEETING.

The papers which were read and discussed at the stated meeting of the Railway Signal Association, and which are reprinted elsewhere, cover two subjects of much interest to the signaling profession.

The source of the power for the control and operation of a signal system is as much of a factor in its ultimate success or failure as any part of it, and, perhaps, has more to do with its efficiency. This subject is dealt with in A. H. McKeen's paper on Portable Storage Batteries.

Unfortunately, however, Mr. McKeen does not seem to be judicial in his attitude toward his subject. His somewhat partisan attitude is emphasized most strongly in his summary of estimated and known costs of portable storage batteries, as compared with primary batteries. For example, no account is taken of the cost of the steel battery receptacles at the bases of the signals, which are necessarily for storage batteries, but are not needed for primary cells. It is true that the case in question accommodates the relays also, thereby obviating the need for separate relay boxes, but there is a decided difference in cost, nevertheless. Although not specifically so stated, one is led to believe that more help would be required per mile of track with primary than with storage battery, but such is actually not the case, as many prominent roads using the former type employ less men, as no special storage battery man is needed. It is also possible to effect important economies by the use of separate line batteries with a primary system, which is frequently done, for one of the chief sources of current drain is the line circuits. No account has been taken of this.

The most interesting and valuable feature of the paper is the set of instructions for handling storage batteries. These instructions embody an important feature too often overlooked, viz., lucid and concise explanations of the necessity for the various rules. Few maintenance men have sufficient technical knowledge to comprehend without such explanations the reasons for the particularly careful handling which a storage battery requires, and generally these explanations are rather difficult to obtain. Such a set of rules should have great value in stimulating the interest of the men in charge, and in inciting them to do their work with intelligence and understanding, rather than as a mere matter of routine.

Now that alternating current is coming rapidly to the front as the source of energy for the operation and control of signals, both for steam and electric roads, a thorough understanding of the various systems offered by the makers of apparatus is an important item of the signal engineer's stock in trade. For this reason the paper on the fundamental principles involved, by L. Frederick Howard, is very apropros. But to do such a subject complete justice would require treatment at a much greater length than Mr. Howard had time or space for, and he was thus forced to condense at the expense of clearness. This was necessary to such an extent that many who are less expert than he in the theory of alternating current could follow him only with difficulty.

Of the two committee reports published in the advance notice, that of Committee No. 10, consisting of specifications for alternating current signal material, is hardly more than an outline, with plenty of blank spaces to be filled in as desired. It is interesting to note that it contains provisions for lower-quadrant and left-hand signaling, two subjects not recognized officially by the association. In fact the association is on record by letter ballot as specifically committed to upper-quadrant signaling exclusively.

The same criticism applies also to the report of Committee I, which consists of a revised system of symbols for signal drawings. Provision is here made also for lower-quadrant indications. Otherwise the system is consistent within itself, though the method of representing the functions and aspects of signals appears rather awkward, and in many instances strained. There are, in addition, many omissions of important functions and aspects, which are supposed to be provided for under the heading of specials. The question naturally arises, why not provide a complete system and secure uniformity on all roads, since that is the avowed object of such a system, and the only excuse for its treatment by the association? Pehraps a simpler system, one capable of being more easily and quickly applied to drawings, could be devised by the use of numbers and letters placed on the blade. In the matter of apparatus, the symbols do not differ materially from those adopted by the manufacturers some time ago and now in general use. There is, however, room for amplification of the matter. For example, should there not be a distinction between an inductive resistance and a non-inductive resistance? Further, it is a matter of experience that workmen have some difficulty in properly interpreting the present signal circuit controller symbols, chiefly on account of their positions with respect to the blade. The scheme now recommended does not remedy this, but seems likely to lead instead to further confusion. Several new and useful symbols have been added, however, and many inconsistencies eliminated. It is earnestly to be desired that before the report goes to letter ballot a complete and consistent scheme will have been worked out from the present one, which is in many respects superior to anything heretofore in use.

PROGRAM.

The twelfth annual convention of the American Railway Engineering and Maintenance of Way Association will open in the Florentine room of the Congress Hotel Tuesday, March 21, at 9 a. m. It will adjourn at 12:30 p. m. for luncheon, reconvene at 2 p. m. and adjourn at 5:30 p. m.

Evening Session.

At 8 o'clock on Tuesday evening an illustrated lecture on steel rails, being a digest of the investigations made by the rail committee, will be given by M. H. Wickhorst, engineer of tests for the rail committee.

Following the lecture there will be an informal smoker in the Florentine room, admission to which will be by membership or guest badges.

Reception and Dinner.

At 7 o'clock on Wednesday evening there will be a reception given by the president and officers of the association, to which all members are invited. This will be followed by the annual dinner in the Gold room.

Exhibition of Railway Appliances.

The Railway Appliances Association will hold its exhibition at the Coliseum during the week of the convention, to which all members of the Maintenance of Way and Signal associations and their friends are invited.

Association Headquarters.

Room 1166 will be used as an office during the convention. Members are requested to register at this room immediately on arrival. Each member on registering will receive a badge and his membership number, a copy of

the official program, and a complete set of committee reports in leaflet form. Unless members desire to do so, it will be unnecessary to bring their copies of bulletins to the meeting.

Convention Program.

(Order may be changed by a two-thirds vote of convention or by time required for consideration of reports.)

Morning session, each day, 9 a. m. to 12:30 p. m.

Afternoon session, each day, 2 p. m. to 5:30 p. m.

FIRST DAY.

Tuesday, March 21.

President's Address.
Reports of Secretary and Treasurer.
Reports of Standing and Special Committees.
XII. Rules and Organization.
X. Signals and Interlocking.
XVIII. Electricity.
Special: Brine Drippings from Refrigerator Cars.
XIV. Yards and Terminals.
VII. Wooden Bridges and Trestles.
XV. Iron and Steel Structures.
XVI. Economics of Railway Location.

Evening Session.

8 p. m.

Illustrated Lecture on Steel Rails, by M. H. Wickhorst, engineer of tests for the rail committee, being a digest of the investigations made by the rail committee.

Informal Smoker.

SECOND DAY.

Wednesday, March 22.

II. Ballast.
III. Ties.
V. Track.
IV. Rail.
VIII. Masonry.
XIII. Water Service.
IX. Signs, Fences and Crossings.
Annual dinner at 7 p. m.

THIRD DAY.

Thursday, March 23.

XI. Records and Accounts.
XVII. Wood Preservation.
Special: Grading Rules for Maintenance of Way Lumber.
VI. Buildings.
I. Roadway.
Special: Uniform General Contract Forms.
XIX. Conservation of Natural Resources.
New Business.
Election of Officers.
Adjournment.

AUTOMOBILE TRANSPORTATION BETWEEN COLISEUM AND HOTEL.

Four automobiles have been provided by the Railway Appliances Association for the convenience of railway officers who desire transportation between the Coliséum and the Congress Hotel. These cars can be identified by streamers bearing the letters, "M. O. W." They leave both the Coliseum and the Congress seven minutes apart, and are available throughout the day for the conveyance of all persons wearing badges indicating their membership in the American Railway Engineering and Maintenance of Way Association, or the Railway Signal Association.

THE INFORMAL SMOKER TO-NIGHT.

Admission to the smoker in the Florentine room, Congress Hotel, to-night, will be by "member" and "guest" badges only. M. H. Wickhorst's lecture on Steel Rails, which will precede the smoker, will begin at 8 o'clock, and be about 30 minutes long.

ELECTRIC RAILWAY ASSOCIATION SIGNAL COMMITTEE.

The committee on signaling of the American Electric Railway Association, of which J. M. Waldron, signal engineer of the Interborough Rapid Transit, New York City, is chairman, will hold a meeting at 9 a. m. Wednesday, March 22, 1911, at the Congress Hotel.

ANNUAL MEETING, RAILWAY APPLIANCES ASSOCIATION.

The annual meeting of the Railway Appliances Association will be held at the Coliseum to-day (Tuesday) at 11 o'clock a. m., in the room above the annex at the south end of the building. Each exhibitor will be entitled to have one voting representative, and such voting representatives are requested to sit on the delegates' side of the hall. The officers to be elected are president, vice-president, secretary-treasurer and six members of the executive committee.

ADMISSION OF RAILWAY OFFICERS TO COLISEUM.

All railway officers are entitled to free admission to the Coliseum. Tickets can be obtained from John N. Reynolds, secretary-treasurer of the Railway Appliances Association. Any railway officer who goes to the Coliseum without a ticket can gain admission by showing to the doorkeeper any evidence of his railway connection, such as a personal card, a railway pass, or an envelope addressed to him. The doorkeepers have instructions to honor every evidence indicating that an applicant for admission is a railway officer.

SPEAKERS FOR THE ANNUAL DINNER.

The following have been invited to make addresses at the annual dinner of the American Railway Engineering and Maintenance of Way Association, in the gold room of the Congress Hotel, on Wednesday evening: B. L. Winchell, president Frisco Lines; S. M. Felton, president Chicago Great Western; John F. Wallace, chairman board of directors, Westinghouse, Church, Kerr & Co.; Sir Thomas R. Price, commissioner of South African government railways and harbors; W. B. Poland; Dr. F. W. Gunsaulus; Rev. R. A. White, and John Barton Payne, general counsel of the Chicago Great Western.

All the speakers have sent acceptances. No subjects have been assigned them.

CHICAGO SIGNAL CLUB.

On Tuesday, March 21, at 8 p. m., the moving pictures taken at Richmond, Va., during the annual meeting of the Railway Signal Association will be shown at the rooms of the Western Society of Engineers, seventeenth floor of the Monadnock building, Chicago, under the auspices of the Chicago Signal Club. These pictures were taken by representatives of the Edison Companies, and they furnish an exceedingly interesting record of some of the doings at the convention. The annual baseball game between the East and the West is especially well pictured.

These pictures were shown in Chicago in January under the auspices of the Chicago Signal Club, and signalmen from Chicago and vicinity found them a source of great enjoyment. It is extremely fortunate that they can be seen again during convention week, as many more signalmen can see them than would be possible during almost any other week in the year. The club invites all visiting signalmen and their friends to view the pictures.

Proceedings.

The stated meeting of the Railway Signal Association at the Congress Hotel, March 20, was called to order by President C. E. Denney (L. S. & M. S.) at 10:15 a. m. The Report of Committee I was presented by J. C. Mock (Detroit River Tunnels), chairman of Sub-Committee 1.

SIGNALING PRACTICE AND STANDARDS.

This committee was instructed to (a) continue investigation of, and report on, a uniform system of signaling. (b) Continue work on standard designs and submit progress reports at the March and June meetings; and (c) advise the chairmen of Committees II., III., and IV., through the chairman, of the work to be performed by his committee which will affect the work of these committees.

Committee I. consists of A. H. Rudd (P. R. R.), chairman; L. R. Clausen (C., M. &. St. P.), vice-chairman; C. C. Anthony (P. R. R.); H. S. Balliet (G. C. T.); C. A. Christofferson (N. P.); C. E. Denney (L. S. & M. S.); W. J. Eck (Southern); W. H. Elliott (N. Y., C. & H. R.); G. E. Ellis (K. C. T.); A. S. Ingalls (L. S. & M. S.); J. C. Mock (D. R. T. Co.); E. P. Patenall (B. &. O.); J. A. Peabody (C. & N. W.); W. B. Scott (Harriman Lines); A. G. Shaver (C., R. I. & P.); T. S. Stevens (A., T. & S. F.); H. H. Temple (B. &. O.); and J. C. Young (U. P.).

C. E. Denney, President.

C. C. Anthony, Vice-President.

SIGNAL SYMBOLS.

At the annual meeting, November 10 and 11, 1903, at Detroit, Mich., there was submitted to the association and discussed, the question of standard symbols. At that time a committee was appointed on definitions and nomenclature, but as very little was done by this committee, the manufacturers, about four years ago, united in compiling a code of symbols for the representation of apparatus on signal plans. This code was considered quite adequate for the demands of that time and was quite universally adopted. Since that time the growth of railway signaling has been so extensive that all have come to realize that advancement must be made in the graphic representation of signal apparatus as well as in the apparatus itself. Railroad companies, as well as signal companies have, therefore, been forced to the adoption of certain special symbols to supply their own demands. This sort of procedure naturally breeds confusion. The manufacturing companies, realizing the necessity for expansion and revision of symbols, recently called together a committee composed of one representative from each signal company to revise the book issued by them in 1906.

Meetings of the manufacturers' committee have been held as follows:

At New York, July 28, 1910, August 19, 1910, August 31, 1910, September 23, 1910, October 7, 1910, November 18, 1910; at Buffalo, December 29, 1910; at Albany, January 12, 1911, January 13, 1911.

The sub-committee on Standards had introduced this subject into its program and it was considered important that the two comittees work together. The manufacturers having done most of the work, the joint meetings between Sub-committee No. 1 and the manufacturers were more in the nature of reviews and revisions. Joint meetings were held at Buffalo, December 28, 1910, and January 25, 1911. At the last meeting, it was decided that the symbols be re-drawn by Subcommittee No. 1 and published in the advance notice for the March meeting.

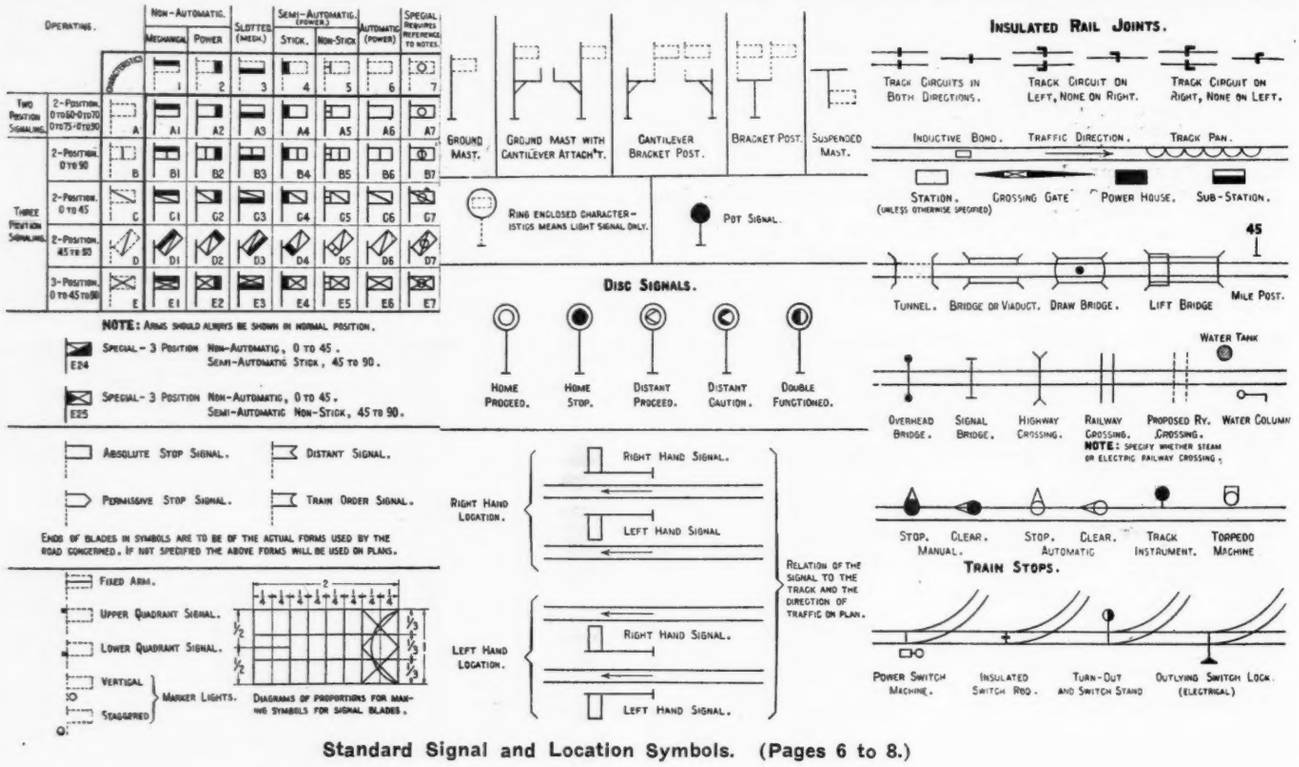
The effort has been to supply symbols that will be adequate and practical, and the importance of simplicity from a draftsman's standpoint has been kept in view. It has also been the purpose throughout to produce a systematic scheme that will be logical and easy to read. Arbitrary features have been avoided as far as possible, and the committee has sought to avoid any more radical changes from former practice than are absolutely necessary.

Pages 6 and 7 have to do with symbols for signals. On account of the very great recent development, not only methods of control, but also in the number of aspects which signals are made to display, it is here that the most radical changes

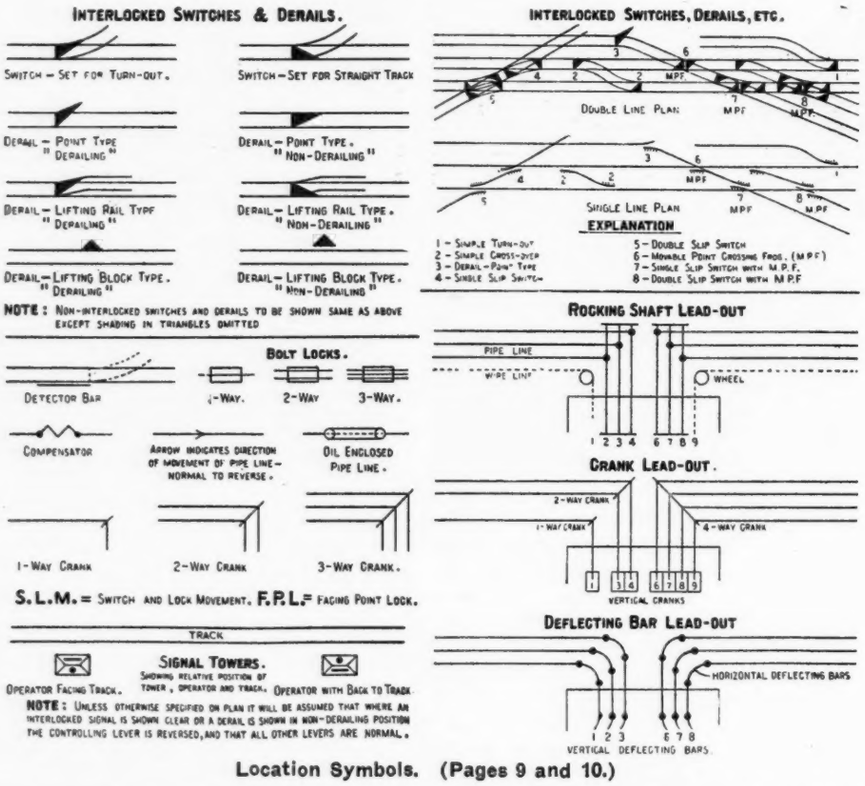
have become necessary. It will be noted on page 6 that the horizontal column of characteristics, which might be termed the characteristics of operation, are grouped under six headings, with a seventh to cover special or unusual features.

By "non-automatic" signal is meant a signal which is in no way controlled by a track circuit, while "automatic," of course, refers to a signal, the primary control of which is the track

As to whether it is, or is not, interlocked will be apparent from its position on the plan and its relation to other signals. It is to be understood that this manual control is direct and that a signal is not to be considered "semi-automatic" because some feature of its control is dependent upon another signal which is manually controlled. By "stick semi-automatic" signal is meant a semi-automatic signal which will not



Standard Signal and Location Symbols. (Pages 6 to 8.)



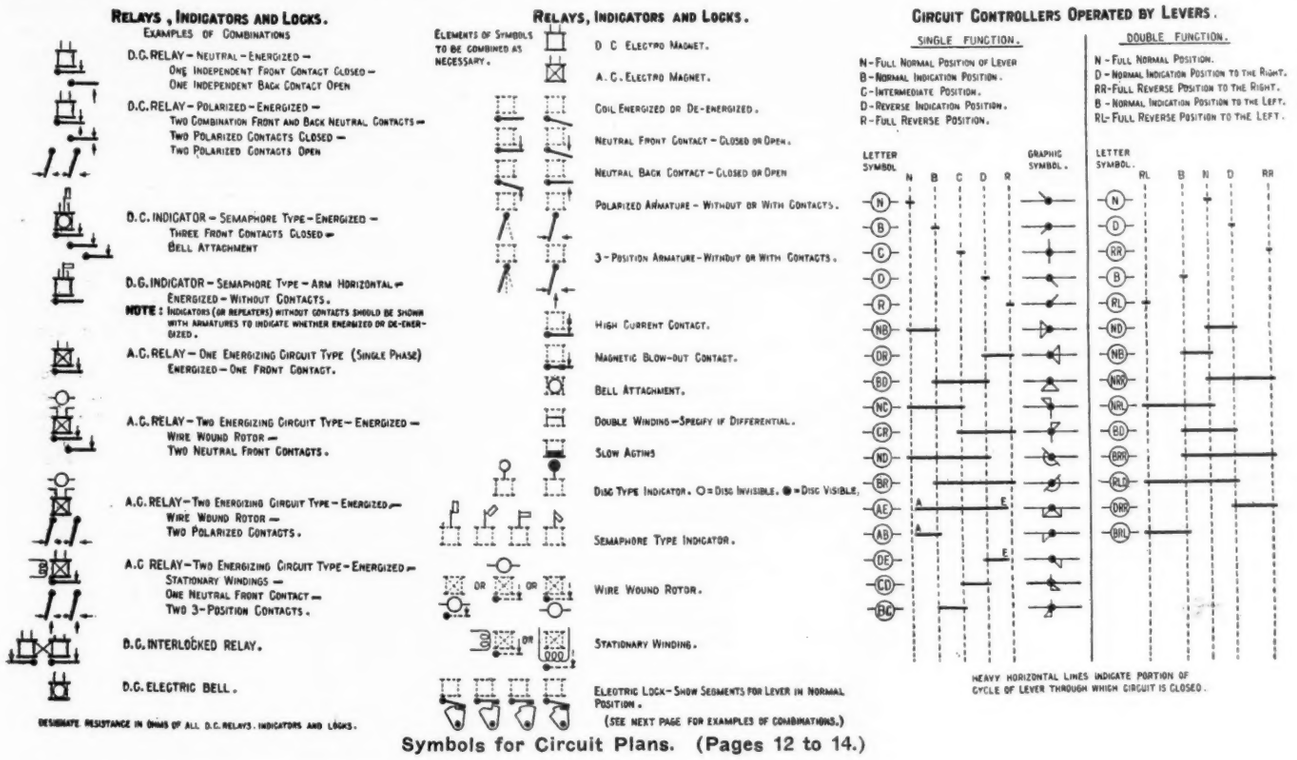
Location Symbols. (Pages 9 and 10.)

circuit, or perhaps more properly, it is a signal which automatically gives indication in regard to the integrity of the track through its block. The term "slotted" is only made to cover a mechanical signal equipped with an electric slot. A "semi-automatic" signal is taken to be a manually-controlled automatic signal and may, or may not, be interlocked.

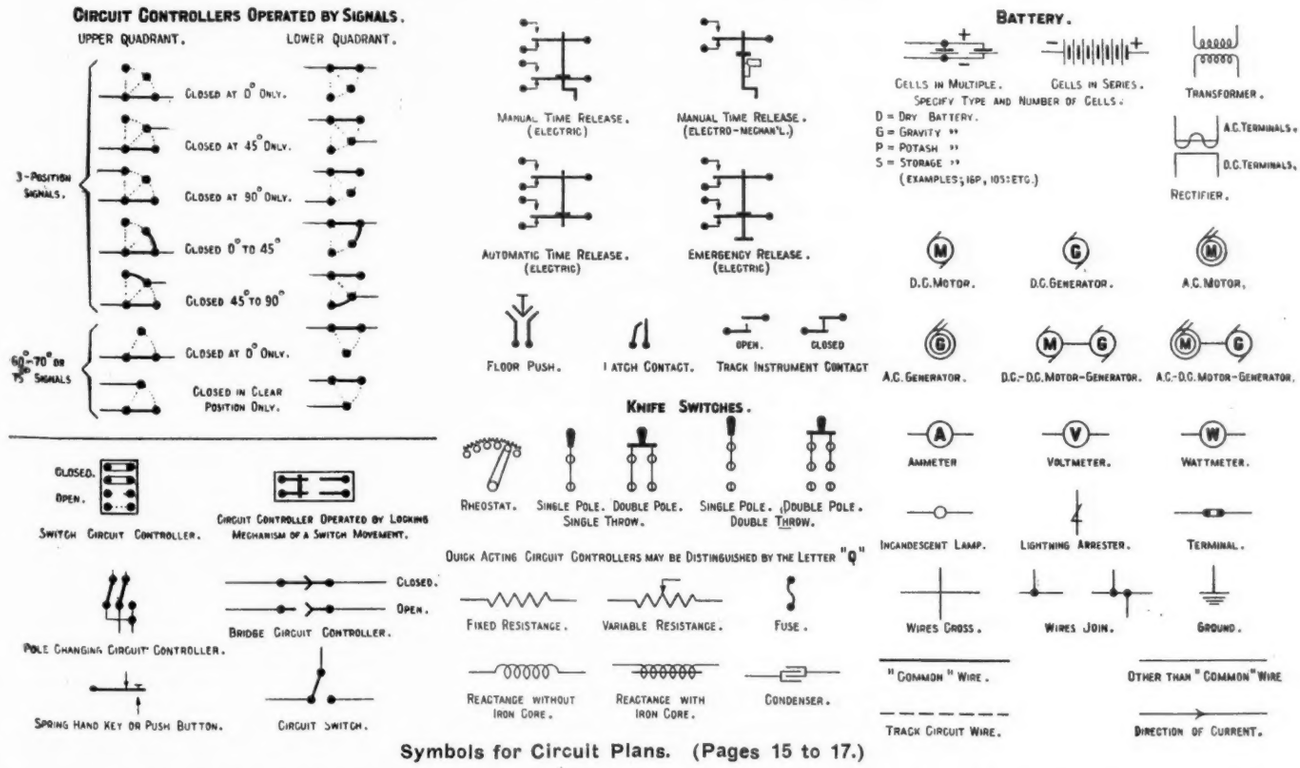
clear automatically after it has been put to stop by interruption of the track circuit until the lever controlling it has been restored to normal and reversed again. A "non-stick semi-automatic" signal is taken to be a signal which will operate automatically as long as the controlling lever is reversed.

Again referring to page 6, it will be noted that the vertical

column of characteristics has to do with the positions which the signal is capable of assuming. In "three-position" signaling these characteristics are represented by lines, which are not necessary in the case of "two-position signaling." The distinction between "two-position signaling" and "three-position signaling" should not be lost sight of. "Two-position signaling" is understood to include signaling where a distinct-



Symbols for Circuit Plans. (Pages 12 to 14.)



Symbols for Circuit Plans. (Pages 15 to 17.)

ive arm is used to display the distant indication, while "three-position signaling" includes signaling where one arm may give both the home and distant indications.

Referring to the 0 deg. to 90 deg. signal in "three-position signaling:" It will be noted that this is distinguished by a vertical line, meaning that it is capable of moving from the horizontal to the vertical. When this signal is shown on the plan in the 90 deg. position, it has the line drawn in the same position with respect to the outline of the blade, but is horizontal with respect to the signal mast, and, therefore, indicates that the signal is capable of moving from vertical to horizontal. The 0 deg. to 45 deg. signal has a diagonal line sloping downward from the signal mast. Theoretically, this line should be at an angle of 45 deg. from the upper left-hand corner of the signal arm, but, for simplicity, in drafting, this is shown in the 45 degree position, the same line means that moves from the horizontal to the diagonal. Where the signal is shown in the 45 degree positon, the same line means that it moves to the horizontal. The symbol of 45 deg. to 90 deg.

signal has the line in the reverse position, and the symbol for the signal taking all three positions—0 deg., 45 deg. and 90 deg.—has both of these lines. It will be noted that the symbol for the fixed arm is absolutely in accordance with the same basic principle.

The committee is thoroughly aware of the fact that there are a great number of different conditions that may enter into the control of a signal; in recognition of this fact, the column headed "Special—Requires Reference to Notes" has been provided. Also two of the more generally used special conditions of control are covered by the two special symbols E24 and E25.

Other features having to do with signal symbols are shown on page 7 and need no explanation. The remaining pages are quite self-explanatory, covering "Location Symbols" and "Symbols for Circuit Plans." An attempt has been made to bring about uniform practice along this line. Heretofore no uniform scheme has been followed. In order to afford as large latitude as possible, both letter symbols and graphic symbols have been provided. Letters have been assigned to the basic positions over which a lever passes—full normal, normal indication, intermediate, reverse indication, and full reverse. Graphic symbols for each of these positions are given, by combination of which all necessary symbols may be derived.

The committee, therefore, respectfully submits this matter to all those interested in railway signaling and asks for hearty co-operation in its universal adoption.

The report is signed by J. C. Mock (D. R. T. Co.).

Discussion on Standards.

Mr. Mock: "If the chairman of the committee on signaling symbols is here, I would like to have him help me out. If Mr. Hovey is not here, I would like to have Mr. Wight. The sub-committee on standards has been requested to supply some material for each of the stated meetings for discussion. We have to offer to this meeting a preliminary report on signal symbols." Mr. Mock then read the introduction to the report, and moved to insert, after paragraph 2, the following: "The following explanation and interpretation of the symbols is substantially as submitted by the manufacturers' committee, and approved by Sub-Committee No. 1."

W. H. Elliott (N. Y. C. & H. R.): It is my understanding that this is a report of Committee No. 1. I would like to inquire whether the remarks of the members of the association to-day will be referred to the sub-committee or the committee for final adoption later by the association.

The President: Yes, it is hoped that we can fully discuss the symbols at this meeting, and unless the sub-committee between now and the June meeting changes them, they can again be discussed at that meeting, so that by the time of the annual meeting, the sub-committee and Committee No. 1 and the entire association will be so well satisfied, or have the ideas that they have in mind so fully explained, that there will be no question about adopting them at the annual meeting; and I assume that the sub-committee will, after securing the advice of the March and June meetings, or whenever they see fit, refer it to Committee No. 1, to be submitted as a part of the annual report of that committee.

Mr. Elliott: Then my understanding is correct, that any action that is now taken is with reference to the recommendation of Committee No. 1 to consider such suggestions.

The President: Yes, and for the advice of the sub-committee on standards. In other words, I believe the sub-committee wants to have the opinion of this meeting on the symbols for their further information.

Mr. Elliott. I would like to ask if it is the intention to discuss each one of these symbols by groups, or as a whole?

Mr. Mock: There was need for quick action on the part of the committee, in view of the urgent request on the part of the manufacturers that a scheme of symbols be adopted at an early date. They have given, as you know, very considerable study to the subject, and, in connection with the report which is submitted for discussion at this meeting, it was hoped that all points, where changes are to be made, might be settled upon at this meeting. I have written the chairman of Committee No. 1, who advises that it is not necessary that the whole committee approve the report until it is ready for submission to the annual meeting.

Mr. Elliott: In looking over this report there are several minor changes which seem to me might be suggested, and in order to have each one separately considered and discussed, I would like to bring up, in connection with the first chart suggested on page 6, which is the most important one, and the one we are most vitally interested in, that the scheme suggested is very complete. At the same time, however, it changes several fundamental symbols, as I would consider it, which we have been using for a number of years, and makes such a wide departure that I think the matter should certainly be given careful consideration. It is very complete, but at the same time I notice that the symbols make use of an outline diagram as well as a diagram which has been partly filled in. The use of these symbols will make it impossible, or at least difficult, for us to show on a plan those signals pertaining to the work shown on that plan, and other signals with which the plan is not concerned, or with which work is not to be done. And yet, while installing the signals, it is desirable to represent on the plan other signals already installed at such places. We use the broad distinction in filling in certain parts of the represented scheme of the signals for such signals as are to be worked on, or are concerned with the particular contract. We use signals in outline, to show that certain signals are in existence, but are not concerned in any work for which we are writing a specification. This distinction makes a very necessary difference which we wish to have shown on the plans. If these symbols are adopted it will be hard to make that distinction.

Then, again, I notice there is a wide difference in that the slant of the line shown on the face of the arm

A. H. Rudd,
Chairman, Committee on Signaling Practice and Standards.

diagonally in one direction to show 0 to 45 deg., and diagonally in the opposite direction, to show a travel of 45 to 90 deg. We have been using these lines to make a distinction between upper and lower-quadrant signals, and have found that to be a desirable and easily followed out distinction. The method adopted by this plan to distinguish between an upper and lower-quadrant signal is shown on the lower part of page 6, by two little dotted or solid lines, on the left side of the "masters" represented. This does not seem a sufficient distinction to enable us to look at a plan and realize what kind of a signal is called for. It is more important, in my opinion, to distinguish on the plan between lower and upper-quadrant signals than between signals of 0-45, or 45-90 deg. Then, again, the particular arrangement of outline diagrams would have the effect that a large part, or practically nearly all, of our plans of signals would be shown in outline, and very few with the solid characteristics. I believe it would be desirable to simplify the symbols between the two-position, 0-90 deg., and the three-position, 0 to 45, or 90 deg., because with the three-position 0 to 45, and 45 to 90, the control in the movement is covered in the lower set of diagrams which are marked E, and the other would follow as a matter of specification. I think one of the lines might be eliminated, and fewer distinctions shown by the symbols.

T. S. Stevens (A. T. & S. F.): Unquestionably every one of us can find something to criticize in these symbols. They will bump up against something which we have

been using continually for years. But the manufacturers present to us here a set of symbols which are consistent, which none of the symbols we have had before this have been; and they are the people who are vitally interested in this proposition. It seems to me a signal engineer should know what kind of a signal he is designing for some point, and should not care what the symbol is; and the only thing we want, it seems to me, is some consistent scheme which we can put on our plans and submit to all the manufacturers, so that they can bid intelligently on the work we want done. I think we should discuss this present report, but I believe it ought to be adopted as something which has been given a great deal of thought, and upon which a considerable sum of money has been spent in its preparation.

W. H. Arkenburgh (C. R. I. & P.). In regard to the distinction between the upper and lower-quadrant signal, I do not see that that is of any particular importance, inasmuch as the association is on record as being in favor of the upper-quadrant signal exclusively. Perhaps it might be as well to have something to show that, but as far as the lines in the main scheme and its indication are concerned, I do not think it makes any difference.

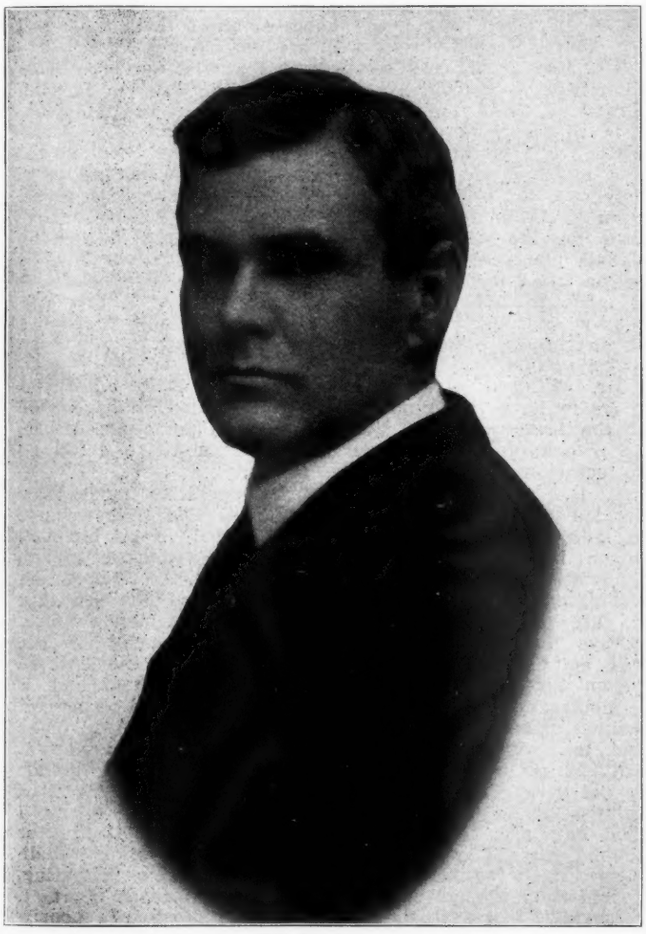
The President: The association has approved certain upper-quadrant signals, but distinctly states in the proceedings that anything is approved which does not discredit existing good practice. Now, we must realize that the manufacturers want to know, when they receive plans, with or without specifications, whether or not the signal is upper or lower-quadrant. While, as Mr. Elliott says, the diagram shown on page 6 would probably not all be used by any one railway, the manufacturers must feel that they are all necessary in order to secure the information which they desire from the railway companies.

I think it would be well if some representative of the manufacturers' committee would give their side of the case, and also state the basis on which this scheme was arrived at. I believe I am safe in assuming that it was not the first one tried. The number of meetings referred to in the report would indicate that the first scheme submitted was not adopted unanimously.

W. G. Hovey (Hall Signal Co.): I met with the manufacturers' committee, and we had three distinct schemes, before we were able to agree upon one. We spent several days on one scheme that looked pretty good to us, when we discovered that the committee was divided on it. Then another scheme was proposed, and we spent several days on that. We got along, we thought, pretty well, and it seemed to be working out nicely. But there were things it did not cover, it was too elaborate, and it appeared finally that we could not agree. Then a certain gentleman on the outside had some suggestions to make that sounded pretty good, and we got busy on them, dropped the first two plans, and worked on the new one, and finally discovered that it was better in our estimation than either of the other two, and we did succeed in getting together. Finally the committee agreed to adopt it, and that is the scheme we are offering you here. We understand fully that other schemes might be presented that would be just as good, and, possibly, better, and that changes could be made which would possibly improve it, but we spent about 15 or 20 days on it, and believe that this is a scheme that covers the present situation fairly well. As to symbol changes that are desired to be made, we are inclined to be liberal, but we, as manufacturers, would like to have some scheme that we would be able to use, a uniform scheme, and this is what we are offering. We believe that we can use it, and we are asking this association to think it over carefully, and see if they can join with us.

Mr. Arkenburgh: I think my remarks were misunderstood altogether. I simply wished to bring out the fact that I did not think it was of sufficient importance to initiate the scheme.

The President: I want to make clear, in replying, that we have both upper and lower-quadrant signals in service, and that if a scheme of symbols is adopted, it will naturally lead to some confusion in railway plans, but more



B. H. Mann, Vice-President.

C. C. Rosenberg, Secretary.

with manufacturers, who have plans from everybody; that is, the old plans won't be right. If, for example, it is desired to put in some three-position signals on a plan that shows some two-position signals, it is necessary, if the plan is to be used after the change is made, to distinguish between the two. For that reason, and because the manufacturers naturally want it, as they are selling a great many lower-quadrant signals, it seems it is as necessary to distinguish one as the other.

Mr. Arkenburgh: I agree with you thoroughly, but the point I make is that the scheme here provides as good a distinction as any, and the mere matter that it is not specific, is not of sufficient importance to make the committee revise the whole scheme to provide something else.

Mr. Mock: As has been said, in particular instances we might improve, but I hope that this committee will be willing to accept the general scheme, and, in order to make it specific, I move that the general scheme as shown on page 6, be accepted.

Mr. Stevens: I think Mr. Elliott brought out an important point, in that there is no provision made to show signal forms on the present plan. I would like to ask if the scheme for showing the form signals could not be shown, and if they would not include a note to that effect.

Mr. Elliott: Answering the point made by Mr. Arkenburgh, I will state if we use signals that do not apply to a particular diagram, we will be in difficulty showing the signals. We have observed on the plans that we now make dotted lines for signals that are to come out and solid lines for those that are to come in.

Mr. Mock: That point was very carefully discussed in the committee, and it was felt that we cannot, by diagram, explain everything. It is a very small matter to make a note on a plan. It is hardly possible, if you have a complicated interlocking system, and part of it is lower-quadrant signals, and part upper-quadrant signals, some to go in and others to go out, that you can show that all clearly by symbols. I think, to avoid any confusion, you should add a note of explanation. I don't believe it is possible, when you consider all of the symbols that are to be learned by the draftsman, which have to be looked up by the ordinary man who looks over the plan, that you could get all of that in without a great deal of confusion. I think we have plenty on the plan now.

Mr. Elliott: I believe it is possible to arrange a scheme of symbols that will give practically all the information here shown, along the line suggested by me, and if the committee will give the matter consideration, I will be pleased to draw the matter up and send in such a diagram. One was almost worked out by me, but there are several little things in it I would like to change. I believe one scheme can be worked out, giving all this information, and yet will let us have outline signals represented as being those that do not refer to a particular plan, and are not affected by a contract, and reserve dotted line signals for those which are to be taken out.

J. M. Waldron (Interborough Rapid Transit): There are some roads which must use the upper left-hand quadrant symbol. There are no symbols here representing that.

Mr. Mock: We cover that by note.

Mr. Waldron: I agree with the chairman, that the upper left-hand quadrant signal would have to go on the left-hand side of the post. There is no doubt about that, but why should not that be covered in a report of this character? It seems to me that the report ought to be large enough to cover the whole field of signaling.

Mr. Stevens: I suggest that any gentleman who feels that way should apply to Mr. Patenall, who will send him a blue-print covering this floor, showing the different things that we can provide symbols for in a signaling system. I have one of them, and I hadn't room for it, and had to put it out of the window.

Mr. Shaver (C. R. I. & P.): It is my recollection that the association has adopted, or one of the committees has worked on the subject, and presented a report on the shape of the ends of blades, and it is my recollection, too, that the train or signal blade had the round end outward. If that is so, I would suggest that this aspect on page 6, the third paragraph, train order signal, be revised to show the curve outward, and then it will be with the shape of the blade as recommended.

Mr. Rhea: I will say that the committee considered that point in detail, and what we have shown in the present instance seemed to be the best knowledge that we could get from the Maintenance-of-Way Manual, and what we found available. It was our effort to make as few changes in the existing signals as possible. Therefore, we left it as we now understand it is shown, and that is the intent of the present symbols.

The President: I believe that affects no other symbols.

Mr. Rhea: I might say in that connection, we also considered some of the existing practices, and the New Haven has the practice that the round end of the interlocking signal is not a train order signal.

H. Fernstrom (Virginian Ry.): I would like to ask the committee if, in answer to Mr. Elliott, it would not be possible to show the signals dotted, and then use the letters to indicate the character of the signal? In answer to Mr. Waldron, it seems to me you simply show the indication on the left hand, and then it makes the report complete. If that does not make it complete, then I think we ought to call on Mr. Waldron to assist.

Mr. Rhea: You will notice in this scheme that we show only an arm that is filled in solid. We would be willing to accept an amendment that an arm of an existing signal, on which no information whatever was intended to be conveyed, would be shown solid. I think you will find that a position that will not disturb anything.

The President: You understand that the action of this committee is not final, so far as the association is concerned. I think the principal question involved on page 6 is whether the general scheme is all right. The committee will, without doubt, refer to the proceedings of this meeting and take care of any special points which they can, but unless the whole scheme is wrong, it would seem advisable to vote on the basis of the scheme rather than on the details. The discussion in regard to the signals displayed to the left of the post can possibly be better taken up as a part of page 7, on which a reference is made to left-hand signaling. Is there any further discussion on page 6? If not, I think it advisable to secure an expression of opinion page by page, and then on the entire motion.

Mr. Waldron: It will take up very little additional space to have this report repeated for the right-hand side of the lower quadrant, and for the left-hand side of the upper quadrant, and then it seems to me there would be no occasion for anyone going astray.

G. H. Dryden (B. & O.): The committee must have decided to change not only the dotted line that we use to indicate a signal that is not intended to be included in an interlocking plant, but also an automatic signal, semi-automatic signal, three-position signal, two-position signal, and every other symbol as far as I can see that we are using to-day. I fail to see the necessity for a change, unless it is in being able to adopt something that will stand, not for to-day, but forever. If the symbol shown for an automatic signal to-day is wrong, and it is necessary to make a change, we should make a permanent change. We ought to be able to look at the plans and tell what any plan means by the signals shown. Nothing has been shown on these plans to tell us whether or not a semi-automatic signal is to be operated by high voltage or low voltage, whether it is to be operated by d. c. or a. c. current; whether it is to be an indicating or non-indicating signal, whether it is to be a battery indicating, high voltage indicating, or induction indicating. Considering the advanced stage of the signaling art, I, personally, feel that the committee has done very poorly, for the reason that the general plan that they propose to use is not flexible. We cannot add to it. The old symbols were adopted, I believe, four or five years ago, and are found to-day to be inadequate. Next year this system may have proved inadequate. I must agree with Mr. Waldron, that if the present symbols are to be changed, we should have a method that covers every branch of the signaling art.

Mr. Mock: I think Mr. Stevens replied to that when he said that by a number and letter scheme you can quickly pick out all the characteristics of any signal on any plan.

Mr. Balliet: That is a fine report, regardless of the knocking it is getting I am going to accept your offer to take this report, page by page, and make suggestions to the committee. I suggest that, on page 7, under right-hand location, at the bottom of the page, it would be well for the committee to show, in arrows, in both diagrams, the track to which the signal mast or the arms relate. I have been mixed up by that with half a dozen men, trying to find out what those indications are intended to be. You can translate them several ways. Assume that, in the upper diagram, we call the top set of lines track A, and the bottom track B. I assume that

the committee means that the two signals relate to track A and should be so arrowed. In the lower diagram they relate to track B and they should be so arrowed.

Mr. Elliott: Acting along the line suggested by Mr. Balliet, that sufficient information will be obtained by the committee, if we merely criticize and pass on without taking definite action, I would make the suggestion that, at the top of page 7, the word cantilever be changed to offset, meaning opposite bracket post rather than cantilever bracket post. I have been using the word offset, and believe it more clearly distinguishes the type of construction.

Mr. Shaver: I did not quite get through with page 6. I have a suggestion that came to me that I think is a very good one, which I would like to offer the committee. That is for a fixed arm tied to the mast, with a diagonal line underneath—something on the order of the cantilever; then the middle line might be done away with, and used for some other symbol.

The President: Page 6, without doubt, covers the portion of the report which was most discussed by the subcommittee. I am assuming these things, but our discussion here would indicate that. Mr. Dryden referred to the fact that the present symbols were almost discarded, and for that reason he did not believe that these would be permanent. That is, the old ones were four years old and had become of no use, and then this scheme was complete. I believe the manufacturers' association can give us a little more information as to how they first started this proposition. They said they had two schemes that were started, and I believe this was the third or fourth. It may clear the matter somewhat in our minds, if they will tell us how they first started, and why they had to change and finally get down to this.

Mr. Rhea: In answer to Mr. Dryden, I stated that we tried to confine ourselves to existing symbols as far as possible. The slotted mechanical signal is identically the same as shown in the present recognized symbols; the mechanical signal No. 1 is only partly shaded because we wanted to have some way of indicating the characteristic lines. The power-operated signal is the same as the present symbol. And, when it came to the question of the semi-automatic signal, we left that as at the present, when it was used, as we term it, as a "stick" power automatic signal. That requires the operation of some lever or button to clear it the second time. As to the "stick" signal, which we considered it necessary to provide for, we simply considered it a step toward the direct automatic. Therefore, we did not shade that part, but simply put a line there, and the automatic signal is as shown by the present symbols. Therefore, I do not see that that top line of characteristics has been very materially changed. In answering the question as to whether we would distinguish between a 10-volt signal and a 55-volt signal, or a 210-volt signal and a 2,200-volt signal, we went over that subject pretty thoroughly, and we found that about the only possible thing that could be done was to use a scheme of nomenclature, to have seven characteristics, instead of two, as we have now. We considered the practical operation of this, and therefore made as few changes in the symbols as we possibly could; and while I contended very strenuously for another arrangement, I have finally adopted this as a good, comprehensive system. The upper vertical line characteristic is that a two-position signal needs no suggestion as to what its other position is from the normal. There are only two positions. The three-position signal is based on the idea that the arm would be shown in a normal position and the lines drawn through the arm will show the position to which that signal shall move. That is the basic principle of the vertical characteristics. The two characteristics put together show your system of symbols, and we believe that that is as far as you can go practically, and we also believe, from our standard as manufacturers, that they will give us the necessary information to figure intelligently on plans that come to us; and I think that we may be warranted in considering the thing as knowing and having experience as to the plans that are being prepared and submitted the country over. The committee, I feel, worked on this thing very thoroughoughly, and we had in the committee men who have had a good deal of different experience with the handling of plans that came from all over the country, and were unanimous in feeling that this scheme of signals is consistent and will give us information that will not be changed tomorrow or the day after. The present scheme of signals was formulated something over five years ago, and it is easy to go back and see the radical changes that have come in the art of signaling within the last five years, and that is perfectly obvious to anyone why the scheme of signals which was worked out some eight or nine years ago, in reality and actually put in the form of a pamphlet some five years ago, would, in that time, be found more or less inadequate to cover the present practice, which has been changed so radically by the very large adoption of three-position signaling when before it was almost universally two-position signaling. Now, when you go to analyze the subject from the standpoint of showing the methods, the way of control, the character of signaling, the currents and the kind of relay you will operate with, I think you will readily see it will carry with it such an enormous amount of information that the only possible way to do it is with a scheme of nomenclature, and if you use that, you will have to work up some sort of a dictionary to carry around with you.

J. Beaumont (C. G. W.): I rise to the support of the committee and the manufacturers' committee. It seems to me that the scheme as outlined constitutes a comprehensive basis of signaling, and that every possible condition is covered here that we might meet in future practice. There are cases where it might be necessary to show additional information, which could be very readily done in the case of one or two exceptions that might not be covered here, where some unusual practice was followed. Now, with reference to the existing practice, there is not a shadow of a doubt but what the New York Central and some other lines will be inconvenienced to some extent in making this change, but as a general proposition I believe that the committee should be supported by this meeting here to-day and that they should carry the endorsement of the association as represented here, excepting only that they should pay proper consideration to the various criticisms and suggestions offered with a view to improving the report, if possible, for presentation at the next meeting, and if I am in order I move that the report as presented be recommended by this committee of the whole.

A. R. Raymer (P. & L. E.): Referring to the bottom of page 6, the symbols about the upper-quadrant and lower-quadrant signals placed on the left-hand side of the symbol, I would suggest it might be a little confusing when used in connection with, for instance D1, where the signal is in the vertical position. I will suggest that the right-hand side of the blade be extended a quarter of a length above or below for upper or lower-quadrant, as the case may be, instead of the little block at the left-hand side of the symbol.

H. M. Sperry (General Railway Signal Company): The committee has done a great deal of hard work and has followed its work somewhat closely. Mr. Rhea has pointed out that the present symbols have been in use about nine, or suppose we say ten, years. That would mean that, in a century, we might have to make ten changes. It seems to me the association can stand for ten changes in a century. I suggest that the association instruct the committee to pay attention to what has been said here and go ahead and get this thing finished.

The President: I believe the understanding will be that if the association approves the general scheme the committee will be perfectly free to act on the suggestions as to page 6, made at this meeting.

Mr. Waldron: If the association approves page 6, will the committee act on the suggestions made here?

The President: Surely.

Mr. Waldron: If the association approves the report as it is now, that will put it up to the committee as being adopted by this association and they will have no authority to change it. We ought to look into that carefully and word it so it will not confine the committee to this particular report, that they should have a full opportunity to take advantage of all suggestions that have been made here.

Mr. Mock: The purpose is to have the suggestions by the members in exactly the way that Mr. Raymer has put it. If you do not adopt the general scheme and you want to present something different from this scheme, we have got to change our methods; in other words, this no longer needs any discussion, and the new scheme will be handed up to the committee and they will work that out. We have regarded this as sufficient, in that we are particularly bound to this until we get something better.

The President: In answering Mr. Waldron's question, this meeting can either approve or disapprove what has been submitted. The June meeting may do the same thing. At the annual meeting the report of the committee will come

up for final adoption by letter ballot. That is the only official action we take. Therefore, we can feel perfectly free to either approve or disapprove the committee's report at this meeting, for the information of the sub-committee making the preliminary report, as stated at the beginning.

Geo. A. Mountain (Board of Railway Commissioners for Canada): Acting on the privilege of addressing the meeting, I ask the committee if they have provided anything which would show a plant that is being changed. Mr. Mock will understand what I mean. We get several plans before the Dominion railroad board, to which I have to give advice, some from the Michigan Central, the Canada Southern division, which indicate the old location and position, and show the old semaphores taken down. We desire to have such information in approving a few notations. I admit it has nothing to do with the diagram that is submitted to the manufacturers for their bids, but I would like to ask Mr. Mock if he has made any provision for that. Our commission desires to have such information to know what changes are proposed.

Mr. Mock: The idea of the committee in joint meeting, that the way in which you could show such a signal was to refer to it in a note with an arrow showing the signal that was to come out, or to be moved a certain distance. There is so much variation in the practice that it is pretty hard to cover it by symbol, except by the dotted line, which is our practice now, or was formerly, and I would like to ask Mr. Rhea if he sees any reason why the dotted line will not indicate that sort of condition?

Mr. Rhea: It is our idea that the prevailing conventionality should be carried out and a dotted line indicate a signal to come out. We expected that this would be shown by indicating the symbols of all the apparatus on the plan, and in case of apparatus which was not changed, it would be shown in ordinary language in the blue print which would show white on the tracing, but on plans on which added apparatus is going in, that would be shown in red, which is the conventional practice. That is the general practice in the case of plans presented to railway commissions in my experience, to show in dotted lines the apparatus which comes out, and in full lines the apparatus which remains intact, and in red the apparatus which is added.

Mr. Elliott: If we could get the committee to show that point Mr. Rhea brings out, that the dotted line is to represent signals to come out, it will make the proposed scheme more complete and desirable.

Mr. Arkenburgh: I wish to criticize Mr. Rhea's remarks. The colors may show different on the blue prints, but they will not do so on the tracings.

Mr. Stevens: As a matter of record, I ask whether it is a fact that the railroad board is very much interested in apparatus that is coming out. If such boards are shown the plan as it is intended to be installed, is not that all that is of interest to them?

Mr. Mountain: There are now in Canada a great many crossings that have the old primitive style of four semaphores, with any old blade, which the board is ordering to be changed into complete interlocking systems. To get thorough information regarding these plans, I require, as chief engineer of the board, that a railway submitting a plan for a new interlocking plant shall show me what system was in use previously, with the location of the semaphores to guide me in saying whether the new ones are in proper position. We do the same thing when plans are submitted for tracks. When the railway submits a new yard crossing it shows the old tracks in dotted lines and the new ones in full lines. I agree with the gentleman who spoke last as to the difficulty of showing these matters in colors on tracings. My idea is that what is old and is to be eliminated shall be shown in dotted lines, and what you are to put in shall be shown in full.

The President: The committee can consider these points in submitting its report. Page 6 refers to the showing of signals from an operating standpoint, primarily, what the signals are to do, and they can well extend the report, no doubt, to cover practices for showing additional information on the plans.

Mr. Rhea: The committee, being largely a committee of manufacturers, is on somewhat delicate grounds on some of these matters. We are not presuming to tell the railways how to prepare plans to submit to railway commissions. We are undertaking to work out signal plans covering conventionalities. As to showing what shall come out and what shall go in, I think that is foreign to the subject we have covered. I have had experience with colored plans and do not think there is any way in which you can so effectively and clearly indicate what you are doing as by the use of colored plans. I have in a number of instances submitted plans of the existing apparatus, and then submitted plans of what we proposed to do, making two distinct and separate plans. That is sometimes necessary, particularly in complicated situations.

Mr. Mock: Will it be necessary to change the scheme submitted if we use the dotted line for signals to come out?

Mr. Rhea: I do not think it will.

Mr. Mock: Is that acceptable to the committee, Mr. Hovey?

Mr. Hovey. I do not believe our committee would have any objection to it, as it is not a symbol but merely a characteristic, and I can see no reason why it should not be used for signals to be taken out of the plant.

The President: The committee appears to be in this position: the manufacturers' committee has offered a scheme which they have submitted through sub-committee 1. If we agree that the scheme submitted is correct, then it will be necessary to ask committee I to extend the scheme and ask the manufacturers if what has been proposed as to the application of the symbols will be satisfactory to the manufacturers, and at that time the points brought out in the discussion can be taken care of.

The amended motion that the general scheme as presented in page 6 be approved, subject to revisions which have been suggested at this meeting, which the committee will take into consideration when submitting the scheme for further discussion and final approval, was carried.

The President: Is there any further discussion of page 7 (second figure)?

Mr. Stevens: I would not like to see the association acknowledge that, in connection with the diagram at the bottom of page 7, an arrow should be attached to the signal to point to the track which it governs.

Mr. Mock: We would not have the other track if the two signals applied to one track. To make it clear I offered a suggestion that an arrow be drawn from the line of track to the signal to which it refers.

The President: It would seem that the plan could be revised without the arrows, if we are to use these symbols on plans where we will not use arrows. I think it is principally a question of proportion in so far as the bottom of this plan is concerned, and can no doubt be revised by changing the proportions.

Mr. Balliet (N. Y. C.): It is a coincidence that the signals are set opposite, and in my opinion it is only a question of rearranging the plan to make the matter clear.

C. C. Anthony (Pennsylvania R. R.): We will have to make a careful distinction between the work of preparing symbols and the work of recommending good practice in signaling. I think we all agree that good practice in signaling is to locate signals so the engineman can tell what track they relate to, but unfortunately not all railways in the country locate all signals in that way. If the signal happens to be without a protecting post and happens to be one track over from that on which it governs trains, it will be necessary on the plan to use an arrow point or some indication of the track to which it relates, so that I am heartily in favor of the use of the arrow points.

A motion to refer the diagrams on the bottom of page 7 back to the committee for further consideration was carried.

The President: Is there any further question on page 7? There has been no motion in regard to page 7 other than the one just passed.

E. A. Everett (Michigan Central): I would like to see some form adopted for unprotected crossings.

The President: The symbol need hardly be anything more than the tracks. If you have one of those boards, with two lanterns on it, perhaps that would be a good indication of the unprotected crossing.

Mr. Mountain: In reference to the last remark, the double-bladed semaphore at a crossing is a death trap. A locomotive driver may do the most serious damage and yet not pass the semaphore. So far as Canadian practice is concerned, that type of a semaphore is abolished.

The President: We will now take up page 8.

Mr. Elliott. In connection with the track pan diagram, I would like to make the suggestion that there be a double line on the inside between the rails rather than these semi-circles. We have been using that as a darkened section in between the rails and it has worked out very nicely.

Mr. Mock: The answer is that the indication here is the one adopted by the Maintenance of Way Association.

Mr. Balliet: As representing the interests of one of the committees, I would like to suggest on the same set of dia-

grams, line 2, that "inductive bond" be changed to "impedance bond." That is what Committee 10 has been instructed to use in all its literature.

Mr. Rhea: Is not Mr. Balliet narrowing the use to one particular application? The inductive bond and impedance bond are different when you analyze them as to finalities.

Mr. Elliott: I would like to suggest the elimination of the circle in connection with the power switch machine. We have been using the little square opposite the switch and found that satisfactory. In reference to the insulated rail joints, we mark the widened line parallel with or from the rail line rather than across it. It is a line very much easier to put in and can be arranged to show as distinctly by a little offset line in the corner as well as parts which are equipped with the track circuit. The mere writing in of these cross lines requires that the draftsman will turn his triangle and rule it with the pen, whereas if the widened line was adopted it could be put in free hand and show very nicely.

Mr. Mock: I think the difficulty is in showing the joint so that it will indicate that the track is to the left or to the right of the track circuit.

Mr. Elliott: I think a little line or corner piece that would readily represent the same thing might be put on. Comparatively few of these lines have track to the left and track to the right, and when this is the case it would be possible to use the present indication.

Mr. Shaver: I think it would be a good plan if the cross marks representing rail joints were shown the same width of line as the tracks themselves. I wish to call attention to the fact that in some places we have to show obstructions along the right-of-way, and I do not see any symbols to represent houses, buildings, trees, hills or mountains. We should have something of that sort, I believe.

Mr. Mock: In regard to showing all the physical characteristics along the line, it seemed to be desirable in some place, but very confusing when you have signals to put in at the same place. I think that is additional information that would be useful but hardly necessary.

Mr. Rhea: The manufacturers' committee considered that entirely foreign. We considered the nomenclature of symbols and similar matters entirely out of our range. We might put in a note referring to the journal of the Maintenance of Way Association. That is the authority we have looked to.

Mr. Waldron: In "train stops" the symbols represented are manual and automatic, but semi-automatic have been omitted, and I think it would be a good thing if the committee would give this a little further consideration.

Mr. Rhea: If we are going into the question of automatic train stops in the same way as we have gone into the indication of symbols, we would have to show illustrations of manual, automatic, non-automatic, mechanical, stick, semi-automatic, non-stick, etc.

Mr. Waldron: It is not necessary to print two or three pages of pictures to represent what you will do. When they are in a vertical position they stop the train; when they are in a horizontal position, that means go ahead. But you have the manual and the automatic, and I think you should also show the semi-automatic.

Mr. Mock: That can be shown by the half circle, shaded.

Mr. Rhea: Cannot you have a non-automatic stop which would be power-operated just as you have a power-operated signal? The one would be power-operated and the other would be pipe-connected, and it seems to me that the situation is somewhat analagous.

Mr. Waldron: On page 8 (the last figure) you have automatic, mechanica and semi-automatic signals. On page 8 (the third figure) we have manual stops. They may be mechanically connected, electrically connected, or electropneumatically connected. There are places where they use semi-automatic in connection with interlocking. Why not include that?

Mr. Mock: Perhaps it would satisfy Mr. Waldron if we present another view with the circle half filled to represent the semi-automatic.

Mr. Waldron: Yes, that would do it.

Mr. Rhea: We would like to ask Mr. Waldron whether the signal immediately adjoining the stop will indicate the character of the stop?

Mr. Waldron: I hardly think so. I think it would give you better results to have the character of the stop indicated separately from the signal. There is a different aspect when you are running in two directions on one track and the train stops would have to indicate for both movements.

Mr. Balliet: Station symbol, line 2, page 8 (third figure), has a platform added to it, because the elongation of the platform in its relation to the station has a great deal to do with signal location on many roads. This point will come up also in another committee report.

The President: You will see that there is a foot note "unless otherwise specified." It may be that the committee had that in mind.

Mr. Balliet: Between "power house" and "sub-station" on the same line, I suggest the committee add a symbol for "signal sub-station." It is very important. The sub-station in the report of Committee 10 will be handled in that manner.

Mr. Rhea: It is not the intention that these signal sub-stations shall be called by a distinctive name. I think the suggestion is a good one, to make a distinction between the power sub-station and the signal sub-station, because it is very desirable to have that brought out.

Mr. Everett: In the designation "track pan," would it not be as well to put in an elongated rectangle there?

The President: The designation of track pan is in accordance with the maintenance-of-way standard. We were really in that position in regard to a good many symbols.

Mr. Balliet: Again in the interest of Committee 10 I suggest that we have this track pan enlarged and add on to it a symbol for a railway with electric propulsion and electric signals to show that there is a double-rail track circuit bonded with power bonds. I would also suggest that the committee consider in this track diagram a symbol for a single-rail track circuit under the same conditions, because one of the rails will be a signal rail and should be differentiated from the power return rail for the electrical engineer. This will give the matter very clearly in our joint relations with the other association. We also need a symbol for the third rail alongside of the right-of-way as well as a trolley overhead.

Mr. Waldron: Mr. Balliet did not go far enough. That is a question of the necessity of showing the upper left-hand quadrant signals.

Mr. Balliet: On the same page, in the fifth set of symbols, I would suggest that the committee consider placing a symbol for track gongs. They are used extensively. This recommendation is suggested by the symbol "torpedo machine." I have another suggestion on page 8. The last symbol in the lower right-hand corner is apparently intended for a switch lock, a hand operated switch in a given position in automatic territory, and not an out-lying switch control for an adjoining or adjacent inerlocking plant. There seems to be a symbol short.

I would like to make the suggestion with reference to the switch box location, that the cross be shown instead of the circle. The cross there seems hardly distinctive enough to be considered a symbol. I would suggest that the indicators be shown vertically along the line, rather than horizontally. There are few places between the tracks where indicators may be shown horizontally on account of clearances, and a vertical arrangement would seem to be a better one. As to the dotted lines for the connections between the battery and the rail, in the case of the track battery, I would suggest that these lines be shown full.

Mr. Arkenburgh: I think we are again short a symbol. We use two indicators on a ground post for the same purpose as they are shown on the cable post. Also, this symbol for track battery is rather inconvenient to make. It is very seldom that we get a plan drawn to the scales shown in these illustrations, and on the Rock Island we have adopted a little letter "b" to set in between the rails. It serves our purpose admirably, and can be made very handily.

W. J. Eck (Southern): In the interest of the draftsman, I suggest on the cable posts, and their lay-out, we leave off the diagonal lines at the top, and join the circles that indicate relays by a straight line drawn perpendicularly to the post and adjoining the circumference of the circles. It will make it very much easier to draw.

Mr. Balliet: At the bottom of page 10, I take exception to the committee's calling this building a signal tower. The Railway Signal Association, the Maintenance of Way Association, and the American Railway Association all call them interlocking stations.

Mr. Shaver: I doubt whether if we call them interlocking stations, that expression will be used. They are always called interlocking towers. That term is almost universally used, and the sooner we adopt it the sooner we will be in line with customary practice.

The President: I do not know that we can revise what the American Railway Association or some of the other

associations are doing. I do not believe that we will be criticized if we call these towers, in our every-day expressions, or something different from their names as printed in the proceedings.

Mr. Elliott: I would suggest that symbol 4—"Derail, Lifting Block Type" under "Derailing" be inverted and shown with the point touching the rail rather than to show a small space between the triangle and rail as the difference between the non-derailing and derailing type.

Mr. Eck: In the same symbol, I suggest the block be shown between the rail as being more nearly a picture of the actual conditions.

Mr. Elliott: I suggest the symbols representing the relay contacts be arranged directly under each other, rather than overhead as shown, because I find on our circuit plans it is necessary and desirable to arrange them vertically, and we put the relay contact in the line circuit rather than to bring the line up to the relay contact, and by showing the contacts directly below the magnet, a clearer diagram is made. I would also like to suggest under the direct-current electric bell that the circle be placed outside of the square, similar to the highway crossing bell, except that the cross lines from the magnet be omitted.

Mr. Waldron: I do not agree with Mr. Elliott about the indication of the contact points in the relay, especially if you have six, eight or ten contacts there. It is a pretty difficult proposition to get the wiring diagrams made out as desired. I think the committee is right as they have represented this.

Mr. Balliet: I wish to call attention to the note which reads: "Designate resistance in ohms of all d. c. relays, indicators and locks." Would it be permissible to suggest to the committee that that sentence be reframed so as to state that the resistance be shown within the circle or within the outline of the apparatus? It is quite an easy matter where you get a good deal of apparatus on a plan to miss that resistance, or to misunderstand just what it relates to.

Mr. Griffin: I believe that would be confusing with the designation of the relay itself. Very often it would be necessary to get four figures inside of some of the symbols we make, and that would be hard, and possibly not clear.

Mr. Arkenburgh: In line with Mr. Waldron's remarks on the clearness of the plans, as I read the instructions, it will be necessary with the track relay to draw two lines from the relay to the rail, representing the two wires.

The President: I assume that is what is meant.

Mr. Arkenburgh: I have found it is much easier to draw and understand if you have one line. There may be a dotted line going from the relay to the point at which it is controlled. On all Rock Island circuit plans we show one dotted line. That does not represent wires, but merely shows two of the points in the track circuit and relay attached.

Charles Stephens (C. & O.): I suggest the symbols show one polarized contact open and one closed.

Mr. Elliott: With reference to knife switches, I would make the suggestion, as simplifying the drawing, that the knife switch be shown as a quadrangle, and that the posts be shown square rather than circular. It can be put in more readily. With reference to "track circuit wire," I suggest that it be shown in full line rather than dotted line, the committee having admitted that a dotted line represents something to be taken out; and also in connection with the symbol for direction of current, that the symbol be eliminated.

J. E. Saunders (A. T. & S. F.): I believe that Mr. Mallett's suggestion concerning the substitution of "impedance" for "reactance" would probably cause different symbols.

Mr. Stevens: I do not like to see the elimination of these different symbols for the different kinds of wire, as suggested by Mr. Elliott.

Mr. Dryden: It is very convenient to have a symbol showing the direction of current, particularly where the current flows in both directions in the wires at various times. I do not know of any better way of showing that than by arrows.

The President: That refers to the last page of the submitted symbols and the committee will be governed by the suggestions which have been made, in completing their work.

Wr. Waldron: In discussing the flow of current, it seems to me that brings up a question we do not know much about. I think we had better leave the arrows off.

Mr. Balliet: We have a symbol for a. c. terminals, which look like a turn-buckle. I appreciate that this is an electrical symbol, representing terms for electric circuits, but suppose we get this symbol on a mechanical interlocking plant, who is going to find out whether it is a turn-buckle.

Mr. Rhea: It is on the wire.

Mr. Balliet: I am not in a position to make a suggestion for something better, because it just caught my eye. I think the committee should give it some consideration.

The President: Unless the chairman of the Sub-Committee on Standards has something further to submit, we will pass on to the next report.

Mr. Mock: The chairman has not anything to offer to the association in the way of standards further than these symbols. I might say here, however, that your letter ballots have turned down some of these standards, which necessarily puts the committee in a position where they do not know just how to go forward. The reduction of the spacing of arms has not been considered by the committee since the return of the letter ballot, but as I see it, we have a good many of our plans to revise, and, of course, that work cannot be undertaken until we know something as to what the association would like to have. The spacing of arms has been presented to the association for three years, and at each meeting has had the approval of the association. When it came to the taking of a letter ballot, it failed to carry. On the basis on which our work was undertaken, we have endeavored to get standards of ladders and lengths of pole which were very much needed and desired for the manufacturers, and I think perhaps that a great many of you do not realize how much work is required to get a standard of what seems to be an insignificant piece of apparatus in signaling, but it takes a lot of time. That spacing of arms is a vital question, and much depends upon the spacing of arms in the apparatus that we will design in the future. It seems to me that the work of this meeting is not too pressing to admit of a discussion, or some expression, of what spacing should be given.

Mr. Stevens: I was rather surprised to see the association vote on that subject as it did, because while I am absolutely opposed and always shall be to that spacing of arms, still I was led to vote for it in committee because the spacing was used by railways in the country, and the function of committee 1 was to provide the necessary posts and ladders to provide that spacing. I was unfortunately too late to register my vote. I had intended to vote for that drawing, with the proviso that it did not carry any approval of the spacing of the arms. That was my understanding of the way we should vote, not on the spacing of the arms, but as to the desirability of the parts which would make up that spacing of arms.

Mr. Shaver: I think it is a fact that a large number of the members do not appreciate the work involved in preparing drawings and specifications for details of such apparatus. It is evident that in voting for the standard posts and ladders, and projecting the drawing to which Mr. Mock has just referred, that they did not carefully consider what it meant. The same thing is true with respect to many of our specifications. We still never get anywhere if the membership does not give more attention to the work in hand, and if they will not work with us, and do not have more confidence in their committees. The members of the committees work these things over and reach the conclusion which in their mind is best. I am inclined to think that the individual ideas are allowed to govern more largely than a consideration of a majority vote.

The President: The association appears now to be in the unusual position of having approved the plant of all details and turned down the general plan. As a matter of fact, practically everything shown on the two plans rejected, namely 1045-A and 1046-A (pages 287 and 288, Vol. VII, 1910 Proceedings), have been approved in the following plans, and I assume that the committee would like information as to what action shall be taken by them during this year in regard to 1045-A and 1046-A, which is a complete scheme for one, two and three arm signals, whether they shall attempt to change the signals or resubmit them. If any change is made in the general plan, then all the detail plans which have been adopted, must be discarded, and others made.

Mr. Stevens: I would like to say a little about the turning down of that plan and also about the general make-up of our reports. A short sentence put in the report of Committee 1 explaining that it is not a question of signal aspect, but the question of the parts of signals, would probably change that vote. If these symbols had been presented to this meeting with a slight argument as to the basis on which they were designed, we would probably have cut out a good deal of the discussion which has taken place to-day, but I do not believe in any of our reports that we explain enough This puts the association in the peculiar position of having approved the details and not the general design. I feel that it was done by error on the part of the members. We have voted for aspects and not the mechanical designs and signals.

The President: On the basis of your remarks, you would prefer to see the plans revised by omitting "aspects," mak-

ing 1045-A read: Diagram of poles and signals, and 1046-A, which shows the bridge and bracket arms, a diagram of signals rather than a diagram of aspects.

Mr. Stevens: That would help the matter. I understand it and told you how I would vote.

The President: It seems unfortunate that the association could not have approved plans of one, two and three-arm upper-quadrant signals. That is what it amounts to. The road can determine whether or not it wants to use the Signal Association standard, but if it does want the three-arm signal, it has an approved plan to work to.

Mr. Stevens: If we do not want to use the three-arm signal, we still have the one and two-arm signals which could be used.

The Secretary: The word aspect should be removed and the vote be taken on the one, two and three-arm signal. It occurs to me it might not be out of order if I would give the chairman the vote as against this proposition, and he could take this up with the members individually and see what their objections were. Possibly the members did not understand it. If it is the sense of the convention that this should be done, it might help us out to know whether or not to revise the plan.

The President: The only person who could authorize that would be the voter. It might be well for the secretary, if desired by the committee, to ask the various members if they agree to have their votes made known to the committee. If so, the committee can then be advised and it can be taken up with them.

Mr. Elliott: I move that be done by the secretary.

Mr. Beaumont: In my opinion, the committee were in error and not the membership. The word aspect should never have been placed before the membership, with the possibility of having to vote on the aspect rather than on the design itself. The vote against the proposition was undoubtedly a vote against the aspect; there is no doubt about that.

The President: It has been moved and seconded that the secretary ask the members who voted against sections 1045-A and 1046-A, if they wish to have their votes made known to Committee 1 and to discuss it with the committee.

Mr. Beaumont: As an amendment to the motion, I move that the two questions at issue be submitted to letter ballot with the word "aspect" removed. I do not see why that could not be done, in view of the fact that the committee was at fault in the first place in asking advice on something that clouded the subject before the membership.

The President: The committee submitted it, and the annual meeting approved and submitted it to letter ballot. This was done and the matter was rejected. Under our constitution this is as far as we can go with it now.

Mr. Beaumont: Is there anything to prevent a letter ballot on the diagram of signal designs?

The President: We call for a letter ballot on the diagram of signal aspects 1045-A and 1045-B, and they have been rejected, and we must have a revised plan on which to vote. The plan is complete in itself and the vote is required on the passing of the plan. If it is the sense of the meeting that this committee shall take up with the members who voted against it the matter of its further discussion, we have again to submit a plan revised as the committee may see fit, at the next annual meeting, which can then be resubmitted without any change in the actual drawing, and adopted. It seems an easy way out of it.

The motion was carried.

Mr. Mann: On this question of revision, I would like to consider the question of the lamp. If you remember, we adopted a five-inch lens, whereas the tentative vote seems to say 5⅜-in. lens as the one in favor. I would like to know how the committee understands that, whether they consider that vote as binding on the association, that the standard lamp has a 5-in. lens in view of the tentative vote?

The President: In reply to Mr. Mann's question, I think it is unfortunate that the vote carried just as it did on the lamp, because it was really more definite than the opinions expressed at the last annual meeting. But the vote must stand, although the committee may revise a plan this year on the basis of the vote on the lens, or on the basis of their further opinion of the fact as to whether or not the lamp as now approved, shall be shown in the Manual, will rest with the Committee on Manual and the Board of Direction.

Mr. Mann: It seems that we are unfortunate in this scheme. The lamp is apparently adopted with a five-inch lens, whereas, as a matter of fact, in voting for the lamp, some of the members voted for it apart from the lens, having in mind, as we had a tentative vote on the size of the lens, that the vote which carried for the lamp did not standardize the lens. It is a matter of error in the understanding of the members, of the vote as submitted by the committee, and it should be handled in the same way as the question of the aspect. If the members did not vote as they intended, and we are now tied up to a lamp with a five-inch lens as the standard of the Association, we should be able to change that vote.

The President: I will read Mr. Mock's motion at the annual meeting, found on page 330; bound volume VII.

A motion to submit semaphore lamp No. 1100-B to a tentative letter ballot to get an expression from the Signal Association on the standard size of lens, and to approve the other dimensions and the general arrangement was carried.

Mr. Mann: I think that the members voted with that motion in mind, and with the idea that the result of the vote was not final, but was simply to get a tentative vote to show which size should be adopted, and I think Mr. Mock had in mind probably to revise the size of lens. I would like to have that brought out clearly, that the drawing of the standard lamp, as adopted by the association, does not fit the size of the lens,—that any road may feel that it is using the standard R. S. A. lamp regardless of the size of the lens.

The President: I think the vote indicates that.

MECHANICAL INTERLOCKING.

This committee was instructed (a) to investigate and recommend a device or arrangement that, with slotted or power-operated home signals, will equally secure the safety of operation of mechanical interlocking apparatus that is at present afforded by the bolt lock in mechanical plants with pipe-connected units. (b) Reconsider specifications for concrete foundations for signal apparatus, considering reports submitted by various committees at the last annual meeting and the specifications of the American Railway Engineering and Maintenance of Way Association, and submit reports for discussion at the March and June meetings, if possible, and for adoption at the annual meeting. (c) Prepare specifications for interlocking for draw-bridges, and specify particularly the requisites for locking rails and interconnecting rail-locks, bridge-locks, and wedges, and the interconnection of these with derails and signals protecting the drawbridge; and (d) submit floor and lead-out plans for mechanical interlocking cabins.

C. J. Kelloway.

Chairman, Committee on Mechanical Interlocking.

Committee II., Mechanical Interlocking, consists of C. J. Kelloway (A. C.), chairman; F. C. Stuart (Sunset Lines), vice-chairman; S. T. Brotzman (L. V.); L. Brown (A., T. & S. F.); F. H. Buchanan (Vandalia); G. W. Chappell (N. Y., N. H. & H. R.); J. Diefenbach (St. L. & S. F.); E. C. Graham (B. & A.); E. Hanson (G. C. & S. F.); William Hiles (C., C., C. & St. L.); J. A. Johnson (M., K. & T.); T. A. Jones (P. R. R.); T. E. Kirkpatrick (L. S. & M. S.); J. W. McClelland (P. & R.); E. E. Mack (C. & E. I.); W. B. Morrison (D. L. &

W.); S. Miskelly (C., R. I. & P.); Charles Stephens (C. & O.); J. I. Vernon (N. Y., H. & H. R.); C. H. Wiegand (N. Y. C. & H. R.); and W. F. Zane (C., B. & Q.).

Discussion on Mechanical Interlocking.

Mr. Shaver: I think there should be a specification for a drawbridge or at least a revision of the mechanical interlocking specifications necessary to apply to drawbridges. I do not believe that the present mechanical interlocking specifications can be interpreted as covering it as fully as it ought to be covered.

The President: The chairman asks if it is the opinion of this meeting that the specifications for drawbridges should begin where the mechanical interlocking specifications now stop; in other words, if it should be confined to the interlocking of the draw-span. It would seem that points covered in the specification we now have would not need to be repeated in the interlocking specifications of the drawbridges.

Mr. Stevens: It strikes me that all this material which the chairman has placed before us is in the nature of practice more than it is specifications. I doubt whether this association properly ruled on this last question. The use of home and distant signals is more or less governed by the speed over the division and the physical location of the drawbridge, and it seems to me it is not proper to be embodied in the specification.

The President: I think we must finally confine our specifications to the methods of installing and protection, rather than to determine the protection to be installed. The membrs of the association may disagree, but that has practically been our practice in the past.

Mr. Stevens: That is my understanding.

Mr. Kelloway: I have been holding out for home signals and referring to distant signals, etc., as adjuncts, which are so termed by the American Railway Association. To my mind, I think we should refer to home signals only, and then refer to adjuncts, and the local conditions will have to govern the man who is going to install the plant, and he in turn will be controlled by the local conditions.

Mr. Beaumont: It would seem on the face of it as though the drawbridge specification on which the committee desires action should begin at the home signal. It is from the home signal that all the protection in connection with the drawbridge has to deal. The points outside of the home signal are points that run with the ordinary interlocking, and it seems to me that this association should keep that in mind, and I suggest that all the specifications that have to do with the drawbridge location, or the protection of drawbridges, begin at the home signal.

Mr. Waldron: Let those gentlemen who are in favor of having a home signal on the drawbridge state whether they use the distant signal in connection with the home signal. It is a very vital thing to protect the drawbridge.

Mr. Kelloway: It depends on locations. I know of a number of drawbridges that are interlocked, and if you put up a distant signal you would have to put it uptown somewhere, because the home signal is right in the yard. There are other points where you could use distant signals to good advantage, and there are points where it would be good practice to put in derails and other places where it would not.

Mr. Waldron: In that case, it would be in the yard limits. Where the speed is high, do you not use distant signals in connection with the drawbridge?

Mr. Kelloway: That is the usual practice.

Mr. Waldron: Should they not include it in the specifications? Is it not necessary to give absolute protection at drawbridges? It seems to me it is one of the most important points to protect.

Mr. Kelloway: The point is, we cannot make a concrete recommendation which will apply in all cases. There are certain points where you require distant signals, and there are other places where you will not need them.

Mr. Waldron: I agree with you. There are certain points where you cannot use distant signals, and do not want to use them, but still we provide for them in our specifications. Here we have a case where we must use distant signals, and why not provide for them?

The President: It seems to me if the committee will specify the interlocking of the drawbridge functions, which is a subject not covered by the present mechanical interlocking specifications, and also make the specifications for the remainder of the interlocking as complete as the mechanical interlocking specifications are, but not make any recommendation as to the amount of protection to be installed at drawbridges—simply specify the way to do it after you decide what you wish to install—their work would be about complete. We have had some questions come up several times in regard to the proper or necessary protection to be recommended that we have made no recommendations of that kind.

The meeting then adjourned until 2:15 p. m.

POWER INTERLOCKING.

This committee was instructed to (a) continue investigation and submit the following typical plans for electrical interlocking, circuits for one-arm signal and single switch, circuits for selecting signals, switch detector circuits, route locking circuits, and approach locking circuits. (b) Investigate and recommend a device or arrangement which will equally secure the safety of operation of electric interlocking apparatus that is at present afforded by the bolt lock in mechanical plants with pipe-connected units. (c) Reconsider and complete specifications for electro-pneumatic interlocking on the lines of the specifications for electric interlocking; and (d) submit plans, similar to those mentioned in (a), for electro-pneumatic interlocking.

Committee III., Power Interlocking, consists of B. H. Mann (M. P.), chairman; W. F. Follett (N. Y., N. H. & H. R.), vice-chairman; W. H. Arkenburgh (C., R. I. & P.); W. A. Bartley (I. R. P.); E. J. Clark (P. R. R.); M. H. Collins (H. & M. T. Co); J. R. Decker (M. C.); G. B. Gray (Penna.); W. H. Harland (N. Y., O & W); R. C. Johnson (N. Y. C. & H. R.); H. K. Lowry (C., M. & St. P.); W. N. Manuel (G. R. & I.); G. A. Motry (B. & O.); H. H. Orr (C. & E. I.); W. M. Post (P. R. R.); I. S. Raymer (P. & L. E.); A. H. Rice (D. & H.); D. W. Rossell (N. Y. C. & H. R.); Hal Smith (U. P.); F. B. Wiegand (L. S. & M. S.); E. Winans (A., T. & S. F.); A. H. Yocum (P. & R.); and G. A. Ziehlke (U. P.).

The committee requested suggestions from any members who have found points that are not covered in the specifications that have now been in use two or three years.

Sub-Committee A was not ready to make a report, but announced two meetings and announced that plans and specifications would be presented probably at the June meeting and surely at the annual meeting.

Sub-Committee B held a number of meetings and has made investigations of the subjects assigned, but was not prepared to make any recommendations.

Sub-Committee C presented as a progress report typical plans covering circuits for one-arm signal and single switch, and for selecting signals, and switch detector, route locking, and approach locking circuits, and also, plans for wood trunking and petroleum asphaltum for "pitching-in" wires.

Sub-Committee E reported progress on the revision of specifications for electro-pneumatic interlocking as suggested in the discussion at the annual meeting. Chairman Johnson requested advice of the association as follows:

Mr. Johnson: There is one matter about which there is considerable difference of opinion in the committee and upon which I would like to have an expression of opinion here. That is the voltage test of electric apparatus. In drawing the specifications which were submitted at the annual meeting we copied this voltage test exactly from the specifications for electric interlocking, that is, 3,000 volts. The criticisms at the meeting seemed to show that that was too high and that 1,000 volts was the proper test. One of the members of the committee says 3,000 is too low; that it ought to be 5,000. I would like to know what some of the other members of the association think about it.

Discussion on Power Interlocking.

The President: You have heard the question on which the committee wishes advice, as to the voltage test to be applied to apparatus. Are there any replies to that question?

Mr. Mann: Is there a representative of the manufacturers that will say why the ordinary voltage test that we use in other signal apparatus should not apply in this case?

The President: By "the ordinary voltage test" you mean 3,000?

Mr. Mann: Yes.

The President: Are there any signal companies' representatives who care to advise in regard to that?

L. F. Howard (U. S. & S. Co.): So far as the insulation is concerned it is the equal of that on other pieces of apparatus, but it would be somewhat difficult, possibly, to provide the 3,000-volt test in some cases. That is merely around the shell and there is considerable distance between the winding and the shell.

The President: In the absence of any further information the committee will have to use its best judgment.

ELECTRIC SIGNALING FOR ELECTRIC RAILWAYS.

This committee was instructed to (a) continue investigation and make further report on the various systems in satisfactory operation, and (b) prepare specifications for A. C. operated automatic signal installations on electric railroads.

Committee X., Electric Signaling for Electric Railroads, consists of H. S. Balliet (G. C. T.), chairman; C. H. Morrison (N. Y. N. H. & H.), vice-chairman; W. P. Allen (Penna.); Wm. A. Bartley (I. R. T.); M. H. Collins (H. & M.); W. F. Follett (N. Y., N. H. & H.); E. C. Grant (U. P.); W. F. Hudson (N. Y. C. & H. R.); John Leisenring (I. T. S.); H. A. Logue (C. V.); W. W. Morrison (N. Y. C. & H. R.); C. A. Peddle (I. R. T.); John Roberts (N. Y., W. & B.); J. E. Saunders (A., T. & S. F.); E. B. Smith (N. Y. C. & H. R.); W. N. Spangler (P. T. & T.); H. S. Towle (Erie); H. C. Ware (N. Y. C. & H. R.); and F. E. Wass (N. Y. C. & H. R.).

This committee submitted a progress report of detailed specifications for material made up by Sub-committee "B." This

H. S. Balliet.

Chairman, Committee on Electric Signaling for Electric Railways.

report includes specifications for electric motor signals; alternating current line-circuit and track-circuit relays; alternating current supply for operating signals, track-circuits, line-circuit relays and indicators, and signal lighting; circuit-breakers for movable-point frogs, switches, or derails, lever and latch circuit-breakers, drawbridge circuit-berakers and special circuit-breakers; bonding materials including copper, galvanized-iron, and copper-clad bond wires, tinned, copper, and copper-plated channed pins, and impedance bonds; electrical conductors including rubber-covered wire, line wire, and cables for low voltage circuits, and line wire and cables for high-tension circuits; wire conduits, including wood trunking, vitrified clay, fiber, and iron; insulations, including rail joints and fiber and switch-rod, pipe-line and tie-plate insulations; and transformers and gird resistance shelters.

Since the report has been printed the chairman has received a number of compliments from manufacturers, and I believe it is only fair that I read, if the chair will permit, taking a little additional time, the corrections which the committee proposes to incorporate in the printed literature, so you will know where we will stand. As a matter of fact, unless there is some decided action indicated, the chairman proposes to leave the specification stand as it is here printed and present it at the annual meeting. That will let everyone interested get in communication with the chairman during the year before we go to press with the annual meeting proceedings, and anything that is vital or that should be incorporated as a committee report will receive its consideration in the full committee. In that way we hope to go to the annual meeting with this report and have quick action. We find that the heading "Detailed Specifications for Material" is very misleading and the committee proposes to have it read: "Automatic block signal a. c. signal system where d. c. propulsion is used. Requisites of Apparatus and Material."

Now, the next heading, "1, Signal A," now reads "Electric-motor signals," and should be corrected to read "Semaphore signals" Under A, 1, should read: "Semaphore signals shall be of the electric-motor type, right, left-hand, upper, lower-quadrant, two, three, position." In other words, we find that "two and three-positions should be inserted and that it should specifically state that they are signals of the semaphore type. We have added "c" in brackets, which, as the correspondence indicates, should include a subject as follows: "The general design, dimensions and structure shall be according to the following drawings"; and we propose to incorporate under that subheading a one-arm signal according to the standard adopted, two and three arms, bracket, mast, bridge mast, etc. In other words, build up the signal structure to which the semaphore mechanism is fastened or included, as it might be, in a mechanism case. Then we want to have another subdivision as follows: "Electric light-type signals," and that shall then be subdivided just the same as the semaphores are. In other words, we find that the light signal is coming in use very rapidly and should not be omitted. Then we find that circuit breakers should really be circuit controllers.

Those are the only corrections of the report as printed that are important. I have before me, however, the proceedings of March 19, which completes the report. If the chairman would like to have me read that I can do it.

Discussion on Electric Signaling for Electric Railways.

The President: On account of the time I believe it is best to hold to the printed report of the committee, but if there are any parts to which the members take exception or any additional points which they believe should be covered so far as the committee has gone, we would be glad to hear from them. There must be some questions on this new subject.

Mr. Waldron: Under A, where it says: "The signals shall be of the electric motor type," does that include signals of the electro-pneumatic type and solenoid signals? Why not make it general enough to include all the types?

Mr. Balliet: It is not possible to make it general. We have worked two or three months on that attempt and that is why we suggest that we make another paragraph, "B." We are perfectly agreeable and willing to incorporate electro-pneumatic and solenoid signals. In other words we will make it "C" and continue indefinitely.

Mr. Stevens: The association has several specifications already prepared along certain lines, and I would like to ask the chairman of the committee if the specifications for the a. c. work could not be prepared along the same general lines as the specifications for d. c. work and mechanical and electrical interlocking have been prepared.

Mr. Balliet: In answer to Mr. Stevens I will say, as announced in the preliminary report, this is a duplicate of the report made by Committee No. 4 and accepted at Richmond last year. In other words, we have simply adapted the terms to the a. c. conditions. We have coined a new word, and forgotten that there is such a thing as a slotted signal. We find that we cannot adapt it to the new method of things, so we have decided in our committee to call it a holding-device and have framed a definition as to what a holding device is. I would like to have everyone give this pretty serious thought, as we have substituted holding-device for slot.

Mr. Balliet: This entire report is framed for the sole purpose of giving it to the layman on a trolley road, or a steam road, so that a man who desires a signaling system can buy a signal system. That is all that the committee was asked to do.

Mr. Kelloway: There is one point under "bonding," No. 5, paragraph A, article B, galvanized iron bond wire. I would like to know if any members here are obtaining iron bond wires. I have recently got into contention with our purchasing agent, and he with the wire manufacturers, that there is no iron wire made to-day. We are getting steel. We have rejected a number of bond wires, with the result that we will have to take steel. I wrote the chairman of Committee 9, which is handling the wire and cable specifications, and sent him copies of letters which were sent to the wire manufacturers, and he advises that he will handle it with the committee and eliminate the word "iron." I would like to see the word "iron" used and obtain iron wires instead of steel wires, if possible.

Mr. Elliott: On the point mentioned by Mr. Kelloway, I did not think this subject would come up and left the letter of Roebling & Sons upstairs, but at any rate they write that while they have previously furnished EBB wires on a specification reading EBB iron bond wires, and considered that the wire they furnished complied with the specifications, they have recently had some orders returned because the bond wires furnished were not actually iron, and they suggested that the specification be changed to cover the kind of ma-

terial now furnished. It seems that practically no straight iron wire is now made, and that if the association wants it it will have to be made out of Norway iron, which is two or three times as expensive as the wire we are now buying. What is furnished as EBB bond wire is a very mild steel, properly tempered and galvanized to serve as a bond wire, and I believe that the specification should be changed to eliminate the word iron in the title. This matter has just come up, and I have not yet had a chance to bring it before Committee No. 9, but expect to do so at the next meeting, and with the approval of the members to suggest at the Maintenance of Way meeting to-morrow that the word "iron" be eliminated from the title of the specification.

Mr. Waldron: It is information that we are after. Iron shows much longer life than steel. Would not the same apply to bond wire?

Mr. Elliott: As I understand this matter, we have been specifying iron EBB bond wires for years in the past, have been receiving mild steel wire, and that practically nothing but mild steel or the quality of iron we are now using has been furnished us for the last ten years or more, and although we had iron in the title and have ordered it, iron has not been received.

Mr. Kelloway: We will all admit that we have received steel wire, but in that case two wrongs do not make one right. Formerly we have used an iron bond wire which has given twice as long service as the present steel bond wire. I know wrought iron bond wire that has been put in the track that have lasted nine years. We cannot obtain that in steel. If the price is going to be more, it is better to specify iron and obtain iron than to specify steel and have to renew the bond wires in four or five years.

The President: While this is interesting, as referring to bond wires, I think it is a subject that should come up in the discussion of the report of Committee 9, because Committee 10 simply referred to the work done by Committee 9.

The President: Yes, I am referring particularly to our newly-printed specifications, which may not be correct.

Mr. Elliott: I would like to say the specifications were worded to cover EBB bond wires and not iron wires; so in order to have the proper title for the specification as worded, the word "iron" should be eliminated, and if it is desired that a straight iron bond wire specification be made up, another one will have to be drawn.

Mr. Balliet: The chairman suggests that, insomuch as the material which is printed in the state meeting literature is in type, it be corrected to date and reprinted with the minutes of this meeting and that the remainder of the specifications be printed with that as information, and that all manufacturers and others who have signals of this type and are interested communicate with the chairman in the next two months, so that we can bring it up at the general meeting and have the report in concrete form for the annual meeting.

The report was accepted.

AUTOMATIC BLOCK.

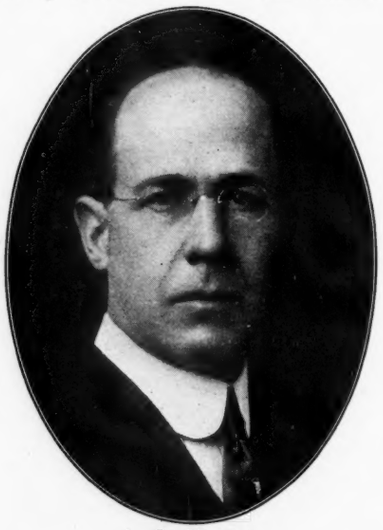
This committee was authorized to (a) reconsider specifications for direct-current relays, which were referred back to that committee at the last annual meeting, and submit new specifications based, as far as possible, on the association's present specifications. (b) Continue work on detailed specifications for material, taking them up in the order shown in the report submitted at the last annual meeting; and (c) supply typical automatic signal circuits for single and double-track railroads.

Committee IV., Automatic Block, consists of A. G. Shaver (C., R. I. & P.), chairman; J. M. Fitzgerald (N. Y. C. & H. R.), vice-chairman; E. L. Adams (L. S. & M. S.); E. A. Allen (N. P.); J. G. Bartell (L. V.); L. R. Clausen (C., M. & St. P.); G. R. Cowherd (A., T. & S. F.); G. E. Ellis (K. G. T.); E. A. Everett (M. C.); J. C. Finch (M. P.); A. R. Fugina (L. & N.); J. E. Gilmor (P. R. R.); W. H. Higgins (C. R. R. of N. J.); A. B. Himes (B. & O.); S. P. Hull (N. Y. C. & H. R.); W. R. Hastings (C., R. I. & P.); E. W. Kolb (B. P. & P.); E. W. Newcomb (O. S. L.); F. W. Pflegling (U. P.); H. J. Rhinehart (D. L. & W.); A. H. Rice (D. & H.); T. S. Stevens (A., T. & S. F.); F. E. Wass (N. Y. C. & H. R.); C. P. Woodson (Penna. West.).

The committee on automatic block reported that the subcommittees have made considerable progress in their work and that the specifications for caustic soda primary battery, switch and tower indicators, and fiber, are under way, some of these requiring revisions only.

Discussion on Automatic Block.

Mr. Shaver: In this regard the chairman ran up against a stumbling block in trying to harmonize some of the various details of the specifications. I am inclined to think that it will be necessary for the committee on manual to meet with these committees and help to straighten out the details of paragraphing and numbering, in order that all the specifications will harmonize and that each be put where there is a specification that is common to all, and you can refer to it and there will be no conflict. This committee No. 4 is open to receive suggestions with respect to any specifications which may have been made, or are to be made, and I think the committee on relays would be very glad indeed to get any suggestions that any member may have to offer. I know that Mr. Stevens has been writing out to a number of the signal engineers to get information.



A. G. Shaver.
Chairman, Committee on Automatic Block.

The President: We will next take up the paper submitted by Mr. McKeen on "Portable Storage Batteries as Applied to Automatic Signals on the Harriman Lines."

PORTABLE STORAGE BATTERIES AS APPLIED TO AUTOMATIC SIGNALS ON THE HARRIMAN LINES.

A. H. McKeen, signal engineer, Oregon-Washington Railroad & Navigation Company, read the following paper:

The application of portable storage batteries to signal circuits on the Harriman Lines began in the year 1890 on the Western division of the Southern Pacific, under the direction of W. W. Slater, then master of signals of that company. At the time there were no motor-operated signals on the Southern Pacific lines and the use of portable storage batteries was confined to operating highway crossing bells and indicator and locking circuits at hydro-pneumatic interlocking-plants. The type of battery then in use was crude, heavy, and of generous dimensions for its capacity. No charging plants were in service, and it was necessary to charge the batteries on an arc circuit, carrying approximately 2000 volts. It was found that a considerable saving was effected through the use of these portable storage cells as compared with the cost of operating the circuits with primary and gravity cells and with a view of extending the use of storage cells to several installations of single track electric automatic block signals that were contemplated, tests were carried on for several years with various types of portable storage batteries on the market. The results of these tests were so satisfactory that in 1899 and 1901 when these several installations of automatic signals were completed, the experimental stage had been passed and portable storage cells were decided on as being the least expensive and most satisfactory source of energy for operating the motor circuits.

Gravity batteries were used for the line and track circuits, although later on, the gravity line batteries were dispensed with and the storage battery served the double purpose of operating both line and motor circuits. Each of the above-mentioned signal installations consisted of approximately 20 miles single track. At the foremen's headquarters of each installation a charging outfit, consisting of a two horsepower gasoline engine, belt connected to a 1-kilowatt generator was installed; the foreman attending to the work of charging and inspecting the batteries, and distributing them to the nearest stations on local passenger trains where they were taken to the battery locations by the maintainer on a velocipede or motor car; the discharged batteries be-

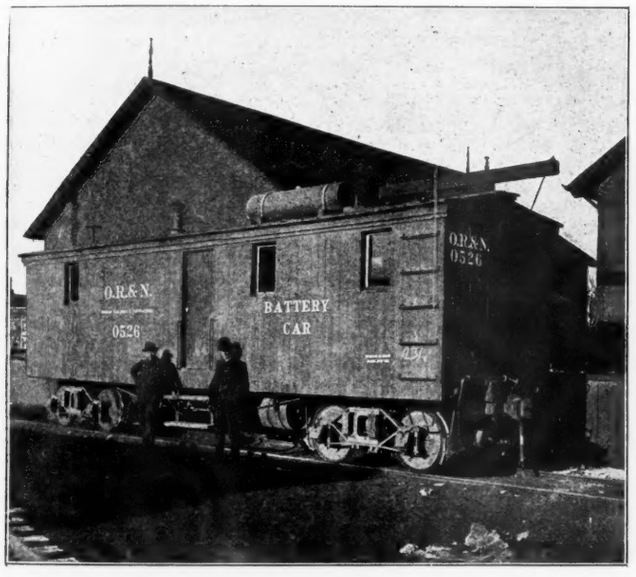
ing returned to the charging plant in the same manner. From this small beginning, the operating officers of the associated lines, comprising the Harriman System, recognized the advantages of automatic signaling as a means of facilitating and safeguarding traffic, with the result that each year, additional mileage of automatic signals was authorized, the amount of such mileage usually being the maximum that could be installed by the signal departments of the various lines during the year. With the close of 1910 the entire main lines of the Union Pacific and Southern Pacific from Omaha, Neb., to Oakland, Cal., a distance of 1779 miles, is protected for the entire distance with automatic block signals, except about 100 miles over the Sierra Nevada mountains, where the electric train staff is in service. Also the main lines of the Oregon Short Line and the Oregon-Washington Railroad & Navigation Company between Granger, Wyo., and Portland, Ore., are protected in a like manner, for the entire distance of 941 miles.

The main lines of the Southern Pacific from Portland, Ore., to El Paso, Tex., and the Sunset Lines from El Paso to New Orleans, a total of 3226 miles, are protected with automatic signals for a distance of 1938 miles, or 60% of the entire distance, and it is calculated that the remaining 1288 miles will be completely signaled within two years. The total mileage of road protected by automatic signals on the entire system, on December 31, 1910, was 4719 miles of single track, and 703 miles of double track, or a total of 6125 miles of track so protected. On this mileage there are 12,050 automatic signal blades, practically all of which are operated by portable storage battery. There are in all 9026 battery locations with a total of 48,516 type SS-7 cells in service, of which 12,412 cells, or 25%, are extra cells used for charging.

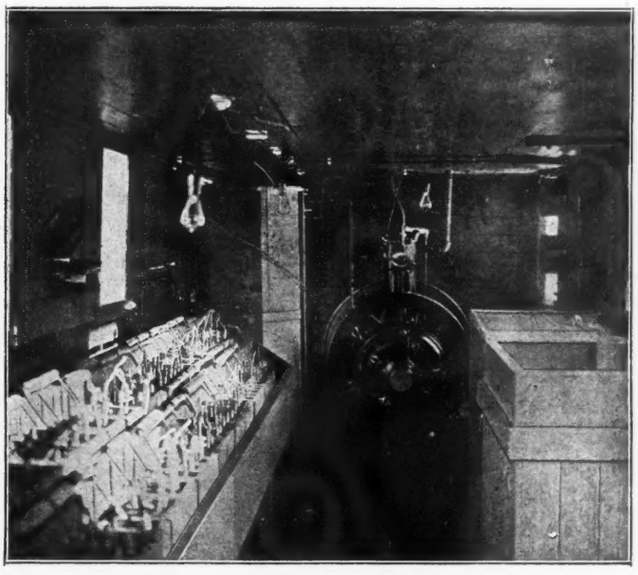
The methods of transportation to and from the charging plants vary with local conditions. On portions of the line where local passenger service is available, the batteries are loaded into the baggage car and distributed at each station by the batteryman, who accompanies the batteries. From the stations they are taken to the various battery locations by the maintainer on a velocipede or motor car, the discharged batteries being returned in the same manner to the station, where they are picked up by the batteryman and brought back to the charging plant on the return train in the evening. On other sections of the line the batteries are loaded into a specially arranged battery car and handled on local freight trains, stops being made at each battery location, where the batteries are changed by the batteryman and the maintainer on that district. The car containing the discharged batteries is sent back to the charging plant on the first freight train. Another arrangement consists of a charging plant built in a box car, which car is moved on the daily way freight and is set out at each alternate station; the batteries being changed out in each direction from the station by the maintainer. This charging car is fitted up in three compartments; in one end of the car is located the gasoline engine, generator, switchboard, and cooling tank. A large gasoline tank holding sufficient gasoline for one month's supply is suspended under the body of the car. The center part of the car is used as a battery room and is suitably fitted up with a battery bench, lead-lined sink and a large water tank for battery washing purposes. The other end of the car is arranged as living quarters for the batteryman. The car is equipped with heavy draught gear in order to avoid any damage due to rough handling while in transit. During the three years that this portable arrangement has been in service, it has given the best of results, handling on one district 832 cells monthly on a territory of 150 miles of single track signals. An important advantage in this method is that on the 150-mile district referred to, only 80 extra cells are required for changing out purposes; this being only 10% of the total number of cells in service on the district.

On the Harriman Lines there are 52 charging plants, each of which (except the portable plants) is located at the headquarters of the assistant supervisor, where a shop building is provided, and part of this shop building is used to house the charging machinery, hence no special building is necessary. The average territory covered by each plant is 104 miles. Whenever current can be obtained from local power companies, a mercury arc rectifier or motor generator set is installed and at other locations where electric power is not available, a gasoline engine and generator charging outfit is used. Each charging plant is in charge of a special batteryman, whose duties consist of charging, inspecting and cleaning the batteries and assisting the maintainers in changing out the cells on their districts. All cells are returned to the plant monthly and are thoroughly inspected and cleaned before being put on the charging circuit. A record is kept in a book, provided for the purpose, of the voltage, specific gravity and condition of each cell on arrival at the plant and each cell is examined for short circuits or other faults; the hard rubber covers and connectors are cleaned and sediment removed if necessary. Once a year the old electrolyte is replaced with new in order to discard all impurities held in solution.

In the case of stationary batteries it is the usual practice to give an overcharge several times a month, the overcharge having the effect of driving the sulphate out of the plates and keeping them in a healthy condition. Portable cells which are charged once a month only, are subject to considerable sulphating and therefore require a long charge to bring them up to capacity. It is the practice to continue the charge for two or three hours after the voltage and specific gravity has ceased to rise. The uniform gassing of all cells on charge is a good indication of their condition and the failure of any cell to gas is investigated before the charge is continued. During the charge, voltage and specific gravity readings are taken and recorded in the book and any cells not coming up to the proper voltage and gravity are closely watched and given special treatment if necessary. Maintainers are required to make weekly inspection of all cells in service, examining them for loose connections, taking voltage readings and replacing any evaporation of electrolyte that may occur during the time the cells are in service. In replacing the evaporation only water whose purity has been



Battery Car.



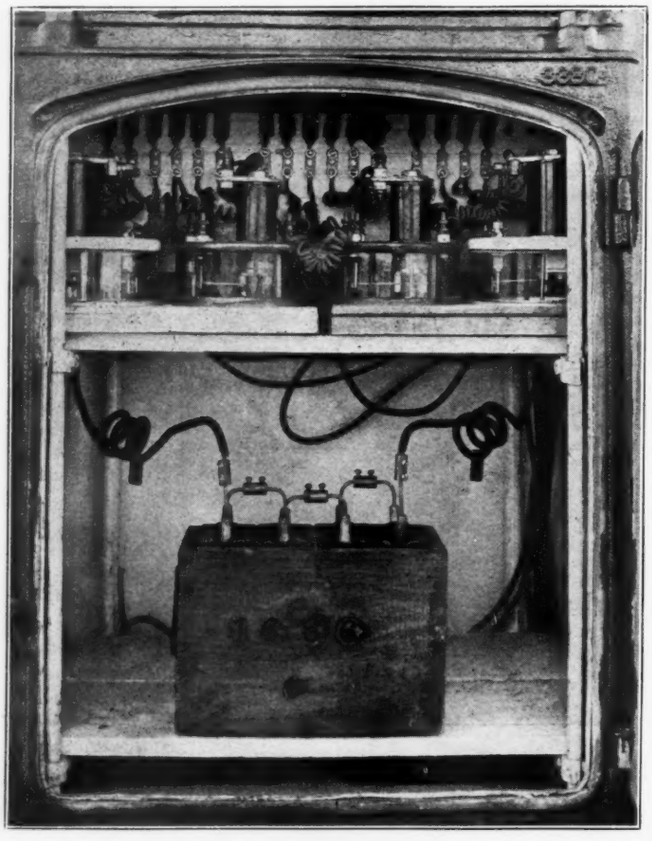
Charging Plant.

previously passed on is used. In localities where pure water is not obtainable, distilled water is provided.

For the guidance of signal department employees the following instruction relative to the care of portable storage cells are printed in the book of rules and regulations of the maintenance of way department:

Assembly and Putting Into Commission.

After unpacking and before assembling the parts, carefully remove from them all packing material or other foreign substance, and make an examination for broken lugs or plates. Also examine the rubber jars for cracks or holes made by nails improperly driven into the packing case. Assemble the cell by placing between each positive and negative plate one each of the perforated hard rubber and treated wood separators, the former adjacent to the positive plates. The smooth side should be placed against the negative plate. After slipping the assembled element into the hard rubber jar, fill with electrolyte of 1,210 specific gravity to a point about one-fourth inch below the cover, and allow the cell to stand in this condition for from six to 12 hours before



Batteries in Signal Case.

beginning charge. No harm will be done by allowing it to stand as much as 24 hours, but this is unnecessary. During the standing period and throughout the charge the height of the electrolyte should be watched (some of the electrolyte is absorbed by the plates and separators) and kept well above the top of the plates and separators, by adding 1.210 electrolyte, but not so high that it will overflow when gassing starts.

Charging should be commenced at the rate of five amperes, and this rate should be maintained throughout the entire length of the initial charge. In fact, it will be found a very practical and convenient rate for charging either new or old cells at all times.

As the initial charge progresses, the cells should be watched closely for the first few hours, and any cell developing a tendency to rise in temperature should receive special attention. If the cell continues to rise until a temperature of 100 degrees Fahrenheit seems liable to be reached, it should be cut out of circuit, to be examined for internal short circuit or faulty connection. It rarely occurs that a cell will show such tendency to rise in temperature, and in such cases the cause is usually apparent upon examination.

The initial charge should be of 40 to 50 hours' duration, not necessarily continuous, but such that the total amount of current delivered to the battery shall be approximately 200 ampere hours.

Note carefully, however, that the mere fact that a cell has received 200 ampere hours' charge is not to be taken as proof that it is in fit condition for service. From the time the initial charge is first begun, a complete record of each cell should be kept, particularly as to voltage, temperature and specific gravity, in a manner to be more fully described later, and this record should be the basis upon which the condition of the cell is determined. After 200 amper hours' charge, a new cell will register approximately 2.55 volts and specific gravity of electrolyte will stand at 1.300 or perhaps a little less. All cells approaching these figures at that time may be considered ready for service. Never on any account begin charging with specific gravity above 1.300.

Ordinary Recharging.

In charges subsequent to the initial charge, the general rule is that the amount of current put into the cell should be twice the amount delivered by the cell during the 30 or less days elapsing since the next previous charge. Under normal conditions and service, the amount of current required of a cell will vary from 45 to 75 ampere hours per month; and the amount of current the cell should receive on recharge will correspondingly vary between 80 and 150 ampere hours. In this connection it should be borne in mind that while the type SS-7 cell has a capacity of only 51 ampere hours at its normal discharge rate, the capacity developed through a discharge extending over a period of 30 days may be as high as 100 ampere hours.

On account of the nature of the service, however, it cannot be known definitely just what amount of current has been delivered from the battery during the month, and it becomes necessary to determine just how many hours the battery shall be charged entirely from voltage and specific gravity readings taken during the progress of the charge.

Just before the cell is placed on charge the voltage and specific gravity should be taken and recorded, and during the progress of the charge similar reading recorded, taken at intervals of about three hours. It will be found that both voltage and specific gravity will gradually rise until a point is reached where charging for two or three hours fails to raise either. Then, and not until then, is the cell fully charged The maximum voltage at this time will vary for cells of different ages, although constant for any particular cell over a period of several months, but the specific gravity of the electrolyte at this point should always be adjusted, if below 1.270, to 1.300 for cells of all ages. It will be found that if cells have not received good care in the past and acid has been added unnecessarily, that the specific gravity will continue to rise greatly above 1.300. This indicates excessive sulphation of the plates, and in such cases the electrolyte should be successively reduced by dilution with pure water, the charge continuing uninterruptedly, until the cell no longer exhibits a tendency to exceed that point. It rarely occurs that a cell will fail to rise to 1.270, but in such an event, and the cell fails to show any rise during a period of six hours' charging, it should be taken off charge and discharged at about 10 amperes to a voltage of 1.5 volts. The electrolyte, which will then register probably about 1.150 or less, should be replaced with new electrolyte of 1.170 specific gravity and the cell recharged. The usual source of such trouble is in the electrolyte having been spilled from the cell while out on the road and replaced with water. Replacement for ordinary evaporation should be made with pure water only, but in replacement for acid spilled of course a certain amount of electrolyte must be used.

Each month, as the cells are returned to the charging station, they should be superfically examined for damaged parts, and the outside of wood cases and tops of rubber jars thoroughly washed. The terminals should receive special attention and all corrosion thoroughly cleaned off and a wipe of vaseline applied. All connectors should be taken apart and rinsed well in bi-carbonate of soda, then in water, and finally, when dry, dipped in some light mineral oil. It is important that corrosion be not allowed to accumulate on terminals and connections where it is almost certain to find its way into the cell.

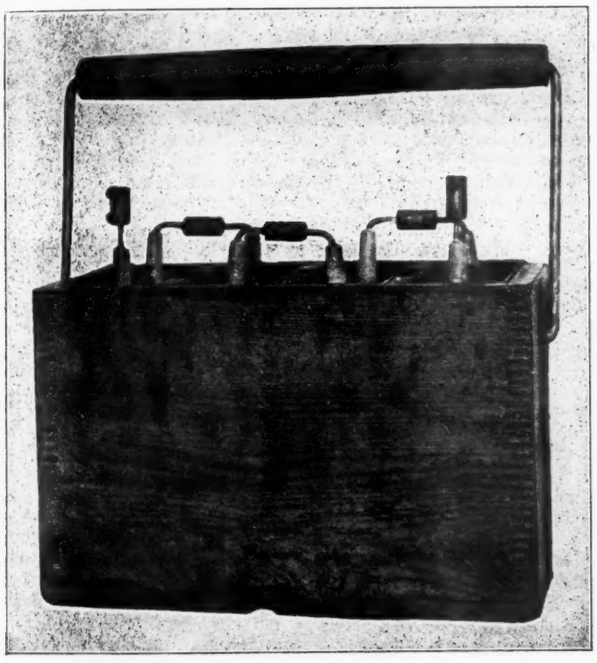
Special Treatment.

Once in six months each cell should be taken apart and closely examined for damaged or defective parts. The sediment should be cleaned from bottom of jar and the plates lightly washed before being replaced. The same electrolyte may be used again. The principal object of this examination is to discover any cell which should be discarded as too old or too much worn to continue in service for another six months, the determination in this case being based principally upon the mechanical condition of the plates with

regard to the amount of active material that has been lost out of them. A system of record should be adopted to insure that all cells receive the examination.

Once each year, the cell, after being charged in the ordinary manner, should be discharged at a rate of 10 amperes to 1.5 volts and a record kept of the ampere-hour capacity of the cell as thus developed. The old electrolyte at this time also should be thrown away and immediately replaced with new electrolyte of the same specific gravity. This is done in order to discard all impurities held in solution in the electrolyte, as it has been found that after a year's work in this service the electrolyte is almost certain to contain a greater or less amount of such impurity. This discharge and subsequent charge are important in more ways than one, and should not be neglected, in that they give a reliable estimate of the value and condition of the cell. Sometimes a cell which has become so badly sulphated as to appear worthless, and one which no amount of continuous charging seems to affect in the least favorably, will be again brought up to first-class condition merely by charging and discharging a few times. If a cell fails to register 40 ampere-hours or more on the first discharge, it should be charged and discharged a second time, and if necessary this process repeated until the requisite capacity is developed or the cell discarded as worthless. If the cell registers 40 or more ampere-hours' capacity on the first charge, a subsequent charge of 25 or 30 hours at five amperes will place it in condition for service.

Cells temporarily out of service should be kept in a fully



Wood Carrying Case.

charged condition by being given a freshening charge of 4 or 5 hours' duration twice per month. If it is not convenient to give them this freshening charge, they should be placed entirely out of commission in the following manner: First, give them a full charge, then remove the plates from the electrolyte and place the negatives and positives separately in water for about one hour to remove all acid. After draining and drying, the positives are ready to store away. If the negatives in drying become hot enough to steam, they should be rinsed or sprinkled with water a second time. When dry, completely immerse the negatives and allow them to stand for three or four hours in electrolyte of about 1.210 specific gravity. After washing and drying as before, they are ready to be stored away. Rubber separators should be rinsed in water and saved, but the wood separators are not worth saving unless comparatively new and in good condition. If saved, they should be kept immersed in water or weak electrolyte. In putting such cells into commission again, treat them as entirely new cells, being governed by the rules relating to placing new cells into commission.

The batteries are arranged four cells to a set, each set being assembled in a wooden carrying case with wood separators between the jars. The weight including the case is approximately 56 pounds per set. On some divisions the jars are set in compound in the carrying case and the tops of the cells sealed, although the majority of the signal supervisors favor having the jars and covers unsealed in order to facilitate inspection of the cells. Where cells are not sealed, the rubber covers are fitted with soft rubber lipped edges, which fit snugly to the sides of the jar and prevents sloppage of electrolyte. The cell terminals consist of a No. 6 copper wire cast into a projecting three inches above the pillar post on both positive and negative groups. The connections between cells are made with a brass battery connector.

The variety of temperatures experienced on different parts of the system has no apparent effect on the batteries and therefore no special housing is necessary to protect them from extremely cold or hot weather. On parts of the line through Idaho, Utah and Nevada the temperature frequently goes as low as 30 degrees below zero, yet no trouble is experienced from electrolyte freezing or batteries failing to operate the signals the required 30 days. During the hot summer months, it is necessary to replace the evaporation of electrolyte occasionally.

The batteries are housed in the lower case of the signal, which makes them easily accessible for inspection. The lower signal case also serves to accommodate the track and line relays. At the end of sidings on single track or other locations where two signals are opposite each other, one set of batteries is used to operate both signals and after the batteries have been in service fifteen days, the maintainer interchanges them with the batteries at the distant signal, this having the effect of equalizing the discharge to a considerable extent on all cells in service and avoids the necessity of charging cells for different lengths of time on their return to the charging plant and also eliminates the possibility of cells being discharged to a point that might result in a signal failure. During the first six months of 1910 there were a total of only 61 signal failures due to weak, dead or defective storage batteries and only 13 failures from poor or broken connections on storage batteries, or a total of 74 failures from all such causes on the entire system, which was less than five per cent of the total number of failures from all causes. The total number of signal movements during the same period was 48,758,000, and the number of movements per failure from storage battery causes amounted to 659,000, which is no doubt a more creditable showing than would be possible if primary batteries were used. In addition to the reliability of operation thus secured, the economical advantages of the portable storage battery over the primary battery, both for installation and maintenance is an important consideration.

Cost of Storage Cells.

1 cell SS-7 storage battery, complete	$4.85
2 battery connectors, @ 8c each	.16
Electrolyte	.03
Freight charges	.30
Total cost	$5.34
Cost of charging machinery and apparatus in 52 plants, @ $450 each	$ 23,400.00
Cost of 48,516 storage cells, complete, including freight charges	259,075.44
Cost of 12,129 carrying cases, @ $2.60 each	31,535.46
Total cost	$314,010.84

Cost of Primary Cell.

1 350-ampere-hour primary cell, complete	$2.00
Freight charges	.20
Total cost	$2.20
Cost of 178,480 primary cells, complete, including freight charges	$392,656.00
Cost of 9,026 concrete battery wells, @ $25 each	225,650.00
Freight charges on 9,026 concrete battery wells, each weighing 1,600 pounds, @ $20 each	180,520.00
Charges for work train and locomotive crane or derrick with crew for unloading and placing 9,026 battery wells, 90 days @ $50 per day (estimated)	4,500.00
Cost of labor for digging holes and setting 9,026 battery wells, @ $10 per well (estimated)	90,260.00
Total cost	$893,586.00

Cost of Maintenance of Storage Cells Per Year.

Interest on investment of $314,010.84, @ 5%	$ 15,700.54
Depreciation on 52 charging plants costing $23,400, at 10%	2,340.00
Depreciation on 48,516 positive groups, costing $1.57 each, @ 22%	16,757.43
Depreciation on 48,516 negative groups, costing $1.835 each, @ 25%	22,256.71
Depreciation on 12,129 carrying cases, costing $2.60 each, @ 10%	3,153.54
Cost of renewals of broken jars, covers and separators on 48,516 cells, at 9 cents per cell per year	4,366.44
Cost of electrolyte renewals on 48,516 cells, @ 3 cents per cell per year	1,455.48
Cost of current, gasoline, oil, etc., at charging plants per year, @ 18 cents per cell	8,732.88
Total cost	$ 74,763.02

Cost of Maintenance of Primary Batteries, Per Year.

Interest on investment of $893,586, @ 5%	$ 44,679.30
Cost of renewals for 178,480 cells per year, at $1 each	178,480.00
Cost of renewals of broken jars and covers on 178,480 cells per year, @ 7 cents per cell per year	12,493.60
Total cost	$235,652.90

With reasonable care, the average life of SS-7 portable cells and their component parts are found to be as follows:

Positive elements	4½ years
Negative elements	4 years
Rubber jars	10 years
Rubber covers	10 years
Rubber separators	10 years
Wood separators	2 years
Carrying cases	10 years

No charges are made for transporting storage batteries either when handled on passenger or freight trains and even though a nominal charge should be assessed, the amount would not exceed the freight charges over foreign lines for renewals for primary batteries. This item is therefore not included in the foregoing cost of maintenance of storage or primary batteries, neither is the expense for labor for charging, inspecting and changing out storage cells or making renewals to primary cells taken into consideration, for the reason that so far as it can be ascertained from Western roads using primary battery, the cost for labor for maintaining primary batteries is practically the same as with portable storage battery. The batteryman looks after the charging of the storage batteries on a district averaging 104 miles, the maintainers assisting in distributing the batteries, which requires on an average two days time of each maintainer monthly. Maintainers' districts range from 14 to 20 miles according to the number of signals, local conditions, etc. **The average district is approximately 16 miles with 32 signals. Maintainers have no helpers and are required to look after** all work in connection with the maintenance of signals on their district including the care of signal lamps.

The prices as shown for both portable storage batteries and primary batteries are the regular list prices less the usual trade discount. The freight charges are figured on an average basis for the entire system and are reasonably accurate.

The cost for current for operating motor-generator sets or arc-rectifier plants varies from one-half cent to five cents per kilowatt and the cost for generating current with gasoline engine-generator sets is about ten cents per kilowatt. Taking an average for the entire system, the annual cost for charging current is 18c per cell.

The foregoing is intended to cover the conditions existing on the Harriman Lines only and is the result of the experience of 20 years with the use of portable storage batteries on those lines. The conditions on many Eastern roads are no doubt radically different. The item of freight charges on material which is purchased in the East or Middle West is a heavy expense for roads in the Far West, although even with the elimination of these charges from the cost of installation and maintenance, the results under the operating conditions in the Far West, would still leave a substantial difference in favor of the portable storage battery installation.

Discussion on Portable Storage Batteries.

The Secretary: I have two criticisms on the paper, and following the usual custom, if there is no objection I would like to read them. The first one is by Mr. Everett, signal engineer of the Michigan Central.

Mr. Everett: The average life of caustic soda primary battery on the Michigan Central, where the battery operates the motor and slot only on normal clear signals, with an average of 33 movements per day, is about 24 months. We have many cases, however, where batteries have run over three years on one charge, and some that are approaching four years. We seldom find it necessary to renew primary batteries during severe cold weather.

Cost to install caustic soda battery (400 ampere hours):

Battery (permanent parts of 14 cells)	$14.00
Shelter (concrete battery box)	11.00
Labor	6.00
Total	$31.00

Maintenance caustic soda battery per year:

Interest on investment at 5 per cent	$1.55
Depreciation of 2 cents	.50
Cost of renewals	6.30
Labor (one-third day each two years at $2 per day)	.34
Total per signal per year	$8.69

Mr. McKeen does not show labor cost. With caustic soda cells, the cost for labor to maintain per signal per year is 34 cents. With storage battery, using a motor car or hand velocipede car the time of trip to each signal would be shorter than for caustic soda cells, but would need to be made twelve times per year, or twenty-four times to one for caustic soda cells.

Assuming on the Michigan Central that it would be safe for one $2 man to carry two sets of storage batteries on his car, and that he could change them out and return in the same amount of time it takes to carry out material, renew primary battery and return, the cost per signal for changing storage batteries would be 34 cents per month, or $4.08 a year. To this must be added labor for handling at stations and charging plants, including shipping in baggage cars or otherwise. Estimated conservatively under conditions such as would prevail on the Michigan Central, this would cost 30 cents per month per battery, or $3.60 a year, making a total for labor in handling storage battery cells of $7.68 per battery per year, as against 34 cents for the caustic soda primary battery.

A few years ago we tried several different makes of portable storage batteries, but found that the cost of handling and transporting was prohibitive.

The Secretary: The second criticism is from E. E. Hudson of the Edison Manufacturing Company.

E. E. Hudson (Edison Mfg. Co.): I have read Mr. McKeen's paper, entitled "Portable Storage Batteries, as Applied to Automatic Signals on the Harriman Lines," with a great deal of interest, and believe a liberal discussion cannot fail to be of value to all members of the association.

It seems unfortunate, however, that the paper is of such a nature as to bring forth a discussion of the relative merits of two devices from a commercial standpoint, in open meeting of the association. It is with the greatest reluctance, therefore, that I felt impelled to resent a few remarks in criticism of some of the statements contained in the paper.

A careful analysis of the figures discloses a number of apparent inaccuracies, and for this reason I feel, in justice to my company and the other primary battery manufacturers, as well as to those signal engineers who have installed primary batteries in large quantities, that accurate data should be presented.

Under the caption of "Cost of Primary Cell," Mr. McKeen gives the price of one 350 A. H. cell at $2; freight charges, 20 cents; total cost, $2.20. The prevailing price of a 400 A. H. primary cell complete, meeting R. S. A. specifications, is $1.95 in less than carload lots, with freight allowed to points east of or on the Mississippi River. In carload lots the difference in freight between C. L. and L. C. L. to Chicago reduces the cost per cell to $1.90.

The item of 20 cents per cell for freight is probably correct for shipments from New York to Pacific Coast or Rocky Mountain points, but it is greatly in excess of what would be the cost of freight on average shipments to Harriman Lines, especially after deducting the allowance made to equalize Chicago delivery.

The most serious objection to the figure shown as representing the cost of primary battery, however, is that the whole cost of the complete cell, including the active elements and the freight thereon, is shown as a part of cost of installation; whereas, the storage cells are received in an unchanged condition and the cost of maintenance starts from the time they are set up (see the advance notice, "Assembling and Putting into Commission"). In other words, the figures supposed to represent the cost of installation of primary cells include practically all of the cost of maintenance for a year or more, and a like charge is not included in cost of installing storage cells. Therefore only the cost of the inactive or permanent parts of primary cells is properly chargeable to cost of installation or first cost.

The price of a 400 A. H. renewal complete is 96 cents, and after deducting this from the price of the complete cell we get a cost for permanent parts of 99 cents per cell in L. C. L. shipments and about 96 cents per cell in carload shipments.

The shipping weight of the complete renewal is almost exactly one-half that of the complete cell; freight on the permanent parts only should be considered as a part of first cost.

A total of 178,480 primary cells is used by Mr. McKeen as a basis for figuring cost, but he does not explain how he arrived at this figure. The storage battery costs are based on 9,026 battery locations. The number of signal locations is not given. I can see no good reason, however, why more than 16 primary cells per battery location, or a total of 144,416, should be considered necessary, as, if it is considered safe to use a battery of four lead-type storage cells

for two signals at double location, it is certainly equally as safe to use a single battery of 16 primary cells of recent standard construction for the same purpose. In most of the cases with which I am familiar where a single series of primary cells is used for two signals, there are 20 cells to a battery, but in these cases the operation of the signals is more vigorous and clearing is accomplished in a shorter period than with 16 cells on a single signal.

The remainder of the figures in Mr. McKeen's estimate of cost of installation of primary cells relate entirely to the cost of concrete battery wells and the cost of transporting and placing them in position, amounting to $500,930 in a total of $893,586. In these costs Mr. McKeen has assumed the installation of a well of the type for which prices are given at each of the 9,026 battery locations. I am of the opinion, however, that even if it had been decided to use primary battery at these 9,026 locations, it is hardly likely that the Harriman Lines' engineers would have installed such wells at about two-thirds of these locations at points where cold weather is not experienced.

In making my estimate of costs I have not considered the use of wells for two reasons—(1) in nearly all of the cases that I know of where wells have been installed they are not used solely for the housing and protection of soda or potash batteries, and (2) because there are some roads using Edison Primary Cells in large quantities, which use wooden battery boxes. The cost of these boxes varies slightly, according to conditions, the average being about $10 each installed.

Using the foregoing corrected figures as a basis of calculation, the cost of primary battery equipment for a single installation similar to that on the Harriman Lines will be as follows:

Cost of 144,416 cells, less cost of first "renewals"	$138,639.36
Cost of freight in carload lots to average point on Harriman Lines, after deducting freight on active elements and manufacturer's allowance 5 cents per cell	7,220.80
Cost of 9,026 bat'ery boxes, installed $10 each	90,260.00
	$236,120.16

I have figured on the cost of cells and that part of the freight to be borne by the railroad as in carloads not only because all cells would be shipped in carloads on an installation of this size, but also because it requires only 1,600 complete cells to make a carload, and any representative job would include sufficient cells to secure carload rates.

The cost of the cell is the regular price to railroads, no deduction being made because of the quantity involved, notwithstanding that it is altogether probable these cells could be purchased at somewhat lower prices in lots of 100,000 or more.

I have not included any charge in the above estimate for labor cost of installing cells, as this was not considered by Mr. McKeen for either type of battery; furthermore, I have no figures covering this point either for primary or storage cells.

C. F. Massey, president of the C. F. Massey Company, has furnished me with the following figures representing the estimated cost of battery wells for such an installation as that on the Harriman Lines.

3,009 for points where extremely cold weather prevails during winter months at $22.00 each	$66,198.00
6,016 wells for other locations at $15.00 each	$90,255.00

The transportation charges estimated by Mr. McKeen on battery wells at $180,520.00 or $20.00 per well may be eliminated almost entirely, as figures given above by Mr. Massey contemplate delivery at some central point on the Harriman Lines.

Mr. Massey states that from his experience and records of cost in setting up those types of battery wells, $5.00 per well would pay for the labor of digging the holes and placing the wells in position.

Revised cost of installation of primary battery using the foregoing corrected figures as a basis for calculation would be as follows, for a primary battery equipment for a signal installation similar to that on the Harriman Lines.

Cost of 144,416 cells less cost of first renewals	$138,639.36
Cost of freight in carload lots to average point on the Harriman Lines after deducting freight on active elements, and manufacturer's allowance, $ .05 per cell	7,220.80
Cost of 3009 style "F" Massey wells at $22.00 each, complete	66,198.00
Cost of 6017 style "E" Massey wells at $15.00 each, complete	90,255.00
Charges for work train and locoomtive crane or derrick with crew for unloading and placing 9,026 battery wells, 90 days at $50,00 per day	4,500.00
Cost of labor for digging holes and setting 9,026 battery wellls at $5.00 per well	45,130.00
	$351,943.16

The figures shown as representing the cost of interest on investment will be reduced materially because of the reduction on first cost of permanent equipment.

Mr. McKeen assumes one renewal per primary cell per year, but the method employed in arriving at this estimate is not given. He states, however, that the total number of automatic signal blades on the entrie system on December 31st, 1910 and 13,050, and that the total number of signal movements during the first six months of 1910 was 48,758,000. Assuming the number of blades to have been about the same during the last six months as during the first six months of the year, the average number of movements per blade per day would have been 22⅓. Under ordinary conditions, a set of primary cells of 400 A. H. capacity would last very much longer than a year on one charge with this amount of work; or even if we assume that a considerable number of additional blades had been installed during the last six months of 1910, and the number of movements or even 30 a day, a set of primary cells would still last very much longer than 12 months on one charge under ordinary conditions.

The amount of energy upon which Mr. McKeen's estimate of the cost of storage battery operation is based may be determined, fairly accurately, by using the figures he has given, and in this way the probable life of primary cells in performing the same service ascertained.

The cost of charging current from small one K. W. plant is given as about $.10 per K. W. hour, and for motor-generator sets arcrectifiers one to $.05 per K. W. hour. As the amount of charging from the two latter methods probably represents a very small percentage of the total, it would undoubtedly be reasonable to assume that the average cost of charging is about $.09 per K. W. hour.

The cost of charging current is given at $.18 per cell per year which would cover an average of 2 K. W. hours per cell per year, or a total input for 48,516 storage cells of 97,032 K. W. hours per year. With this information, it is only necessary to determine the efficiency or effective output from the cells to ascertain the amount of current used per year in the operation of the signals on the entire system. This can also be determined approximately by the use of figures given.

It is stated in reprint from the book of rules and regulations of the maintenance of way department, under the heading "Ordinary Recharging" (see Advance Notices) "Under normal conditions and service, the amount of current required of the cell will vary from 45 to 75 A. H. per month; and the amount of current the cells should receive on recharge will correspondingly vary between 80 and 150 A. H." In other words, the ampere hour output is only one-half of 50 per cent. of the ampere hour input. The watt hour efficiency is much less, however, because of the difference between the voltage on charge and discharge. The charging voltage must be about 2.6 per cell, while the mean discharge voltage is 1.98, therefore, it reqires an input of 260 watt hours to obtain an effective output of 99 watt hours, the efficiency in service on this basis being 38 per cent. under normal conditions. But if we take into consideration the current used in a special treatment of cells, as required by the book of rules, as well as the various other losses due to local action, reduction of output in cold weather and the charging of cells not fully discharged in order to avoid sulphation, and we will probably find that the actual efficiency in service does not exceed 30 per cent.

Taking this percentage of efficiency as a basis, it will be seen that from an input of 97,032 K. W. hours for the 48,516 storage cells the effective cutput is 29,110 K. W. hours.

To find the equivalent ampere-hour capacity in primary cells necessary to reduce this amount of energy it is only necessary to take the total of 144,416 primary cells required to displace the total number of storage cells, multiply by .6 the mean working voltage per cell under such conditions as prevail on the Harriman Lines, and divide the product (86,650 volts) into 29,110,000 watt hours (29.11 K. W. hours). This will give us a result of 336, representing the average ampere-hour consummation per year if primary cells were used on this installation.

At this ratio, cells of 400 A. H. capacity would last 14⅛ months on one charge. This estimate compares favorably with the service that is being obtained on other roads where the conditions of service are about the same as those on the Harriman Lines.

At a cost of $.96 per renewal, this makes the renewal cost per cell $.80 per year, without considering the value of the scrap. But as an allowance of $.16 each is made for the exhausted copper oxide and zinc plates when returned to the

manufacturer a still further reduction should be made. This allowance will net the railroad company, after deducting freight, about $.14 per cell, or $.12 per cell per year in this case making the net cost of the renewal $.68 per cell per year instead of $1.00 as shown.

The third item of $.07 per cell per year for the replacement of broken jars and covers is entirely too high. In order to determine just what this amounts to, I went through our records covering shipments of extra jars and covers for one year to a number of roads representing a total equipment of about 110,000 cells, and found that we had shipped to these roads 876 extra jars and 432 extra covers during the year. Assuming all of these jars and covers to have been required for replacing broken ones, the annual percentage of breakage would be 7-10 of one percent or about 2-3 of one cent per cell per year, including freight.

With these figures we are able to arrive at the annual cost of maintenance, for such an installation would be as follows:

Interest on investment of $236,120.16 at 5 per cent..	$11,806.00
Cost of renewals for 144,416 cells per year at $.68 each	98,202.88
Cost of renewals of broken jars and covers on 144,416 cells at 2-3 per cell per year.....	962.78
	$110,971.66

I cannot agree with Mr. McKeen in his assertion that the cost of labor in handling storage battery is not greatly in excess of that required for the renewal of primary cells. Even if we assume that there would be thirty-two sets of battery on each maintainer's section, the renewal of this number of primary cells would not require more than two days a month that is now devoted to the distribution of storage cells. This leaves the entire cost of the special batterymen chargeable to storage battery maintenance, as being in excess of the labor rquired for th care of primary cells. As each of these men cover a section of 104 miles, I take it there are about 52 on the entire system, and if we place the salary of these men at $100 per month there should be added $62,400 a year for the cost of storage battery maintenance.

The revised figures for maintenance, after including these additional items, are as follows:

Original estimate	$ 74,763.02
Interest on cost of lower battery cases and installation of power houses, $269,702, at 5 per cent..	13,485.10
Fifty-two special batterymen at $1,200 per year....	62,400.00
	$150,648.12

The President: Gentlemen, we are full of figures. This paper is without doubt interesting as a description of portable storage batteries as applied on the Harriman Lines. We have had Mr. McKeen's statement of the cost of the storage battery and the estimated cost of the primary batteries and we have heard that it is not all so. We cannot devote much time to the discussion of cost in this connection. I do not think it is advisable to do it, at any rate. Are there any questions in regard to relative merits of service given by either types which would be of information to other members? We can well spend some time in going over it, but we cannot begin to dispute figures, because we haven't any figures. They have them all, and it is hardly within the province of the association to decide whether primary or storage batteries should be used by the railways of the United States. Probably they want to use both. Conditions may vary somewhat. I think the remarks should be confined to the relative operating merits of the scheme. We have heard both sides as to cost, and if there are any questions relating to methods of charging or details of operation we can spend a few minutes on discussion.

Mr. Shaver: I would like to quote a few figures, as a matter of record and information for the association. They are actual figures. We have kept an account of some of the details of work constructed last year, and we found that the actual cost of setting 224 battery wells, of the kind listed in the Massey Company's catalogue as Style C, cost us $5.67 each. The cost of setting up 3,520 cells of potash battery, which includes unpacking and disposal of the rubbish and the like, was thirteen cents a cell. I might explain that this can be done more cheaply, but we have learned to use a great deal of care in setting up a primary battery, and our men take sufficient time to be absolutely sure that all the caustic soda is dissolved and the temperature right before putting it in the well. In giving this question study we have found that battery boxes can be used with good results, such boxes as we have used costing us about $7.00 each, but special care is necessary in the maintenance in some of the colder climates. Then again we find that it is an advantage to have one receptacle in which we can place gravity battery. Therefore, we are using a battery well. In our southern territory we can use a well that is more shallow and costs less money. We paid about $18 each for those wells, while in the northern territory we have been using a deeper well that will keep the gravity battery below the frost line. Such batteries have cost about $45 each. As to the life of a caustic soda battery, a great deal is dependent upon the circuit and the style of signaling used. We have some signals installed with control circuits that lead from the potash battery that operates the signal, and a very careful record kept of that battery showed an average life of a little better than 11 months; in some cases it ran as high as 13 or 14 months. We have other signals with different circuits, where the life of the battery is not so long. Then, again, climatic conditions cut some figure. So I believe it is impossible to make a comparison as between railways. It is, however, possible, to make a comparison as to the cost between different parts of the same road where climatic conditions and the circuits are the same, but unless the circuits and traffic conditions are the same no good comparison can be made.

Mr. Dryden: Nothing has been said concerning the method of charging by means of gravity cells. On the Baltimore & Ohio we have 500 signals operated from a storage battery charged by a gravity battery. On a four-track road one group of six cells of storage battery operates four signals and lights four signals. The charging circuit is from 18 to 22 cells of gravity battery. The life of these batteries is from five to six weeks. The efficiency is all that could be expected.

Mr. Shaver: If Mr. McKeen's article is included in the literature of the association it would be of considerable benefit if we could have a plan of circuits showing the resistance of the various relays and slots, together with a statement of traffic. That, with the figures given, would be a basis for anyone to make comparisons with his own line if he wishes to do so. A vote of thanks was tendered to Mr. McKeen.

The President: We will take up the next paper, "Principles Governing the Selection of Alternating Current Signaling Apparatus," by L. Frederick Howard.

PRINCIPLES GOVERNING THE SELECTION OF ALTERNATING CURRENT SIGNALING APPARATUS FOR RAILROADS.

L. Frederick Howard presented the following paper:

The object of this paper is to state the principles which call for attention in the selection of alternating current signaling apparatus, and to discuss their bearing on the system embodying such apparatus. Both electric and steam road conditions are considered.

Inductive Bonds.

From the point of view of the signal engineer the inductive bond constitutes a leak from rail to rail for the alternating signaling current, the same as do the ballast and ties.

Referring to Fig. 1 it will be seen, however, that, while the leak through the ballast is distributed through the bonds is concentrated at the ends of the track circuit, being the greatest of course through the bond nearest the transformer where the voltage is highest.

Furthermore, since the bonds constitute an inductive leak, while the ballast and ties constitute an ohmic leak, the actual sum of the two kinds of leakage is less than the arithmetical sum.

The leakage through the ballast increases with wet weather. The leakage through the bonds increases when for any reason unequal amounts of propulsion current above a certain value flow through the two halves of the bond winding.

When this inequality exists the bond is said to be "unbalanced."

The unbalancing current is the difference between the values of the propulsion current carried by each rail, and flowing in either half of the winding. The iron core of the bond is magnetized by this unbalancing current as well as by the signaling current. The measure of the magnetizing force of the propulsion current in ampere turns is the unbalancing current in amperes multiplied by one-half the number of turns in the bond. Under ideal conditions no unbalancing exists, each rail carrying an equal portion of the total propulsion current.

Now when iron is magnetized to a certain point, an increase in magnetizing force does not produce as great a change in the degree of magnetization of the iron as it would if the iron were not magnetized to that point.

Hence it comes about when unbalancing occurs, that the iron core being magnetized to a certain point by the "unbalancing" portion of the propulsion current, the alternating signaling current passing through the windings does not produce as great a change in the magnetization as if equal

amounts of propulsion current were flowing in the two halves of the winding, which would be the ideal condition. The reactance therefore decreases and more alternating current leaks through as the unbalancing increases.

To decrease the variability of the leakage through the bond with variation in the unbalancing, there is introduced in the magnetic circuit of the bond an element which, while it will not allow as much magnetic flux to pass with a given magnetizing force, will always, when considered by itself, give a change in flux corresponding to the change in magnetizing force. This element is air, In other words, an air gap is provided in the magnetic circuit of the bond.

The iron may be looked upon as the element which gives to the bond a low but variable value of leakage, making the bond sensitive to unbalancing.

The air gap may be looked upon as the element which gives a high but more constant value of leakage, and lesser sensitiveness to unbalancing.

The typical curves, Figs. 2 and 3, illustrate this. The ordinates show the amounts of alternating current which will leak through the bond when the A. C. voltage marked on each curve is applied across the terminals of the bond, and when the values of unbalanced propulsion current correspond to the abscissae.

In one set of curves there is no air gap in the magnetic circuit of the bond. In the other there is an air gap of 0.05 in. With 0.4 volt A. C. across the bond terminals it will be seen that with no unbalancing the "leak" is 2.5 amperes in the first case, and 4.5 amperes in the other. For the same A. C. voltage but with 160 amperes unbalancing the "leak" is 5.0 amperes and 4.0 amperes respectively.

The decrease of the "leak" with small amounts of unbalancing, (Fig. 3) is due to the fact that at certain stages of the magnetization of iron a given change of the magnetizing f rce (in this case the alternating current) produces a greater corresponding change in the degree of magnetization, and consequently the reactance increases.

The point at which the leak through the bond increases is not necessarily of course the failing point of the track circuit, for this depends also on the factor of safety allowed in the supply of energy to the track circuit.

That is to say, so far as the signal engineer is concerned, he can avoid signal failures due to unbalancing by using a bond with no gap or small one, and using a sufficiently high voltage on the track circuit to take care of the variations due to unbalancing, or by using a large air gap and taking more current initially. In both cases, however, the provision for unbalancing means an expenditure of energy, but with the advantage in favor of the bond with the air gap, because of the increased stability of the track circuit and consequent reduction of voltage variations across the terminals of the relay.

As stated before, the magnetizing force due to the unbalanced propulsion current may be expressed in ampere turns. Therefore, if an unbalancing of 300 amperes, for example, exists in a bond with eight turns, and the tap at the middle, the magnetizing force due to the unbalancing is 1200 ampere turns.

For the purpose of testing how this degree of magnetization is going to affect the "leak" of the alternating signaling current, we can, where a current of say 300 amperes is not available, use a test coil of a large number of turns and taking correspondingly less current.

We cannot apply our alternating voltage to the same coil, however, for the meters would not differentiate between the two kinds of current, so another winding is necessary for the alternating signaling current preferably of low enough resistance to give no appreciable resistance drop.

But the first coil will now act as a secondary to the coil carrying the alternating signaling current, and an A. C. voltage will be set up in it causing reactions on the coil carrying the alternating signaling current which would vitiate the readings. Two bonds with their test coils are, therefore, connected as shown in Fig. 4 to neutralize this transformer action in the coils carrying the propulsion current.

The desirability of a small leak through the bond is accentuated by the fact that all the current leaking through the bond at the relay end of the track circuit has to be transmitted over the rails, with an increase in the voltage across the rails opposite the transformer, over the voltage across the rails opposite the relay, sufficient to compensate for the drop in the rails. The more the current taken by the bond the more the drop over the rails and consequently the higher the average voltage across the rails. This in turn means greater leakage through the ballast, and through the bond opposite the transformer.

But for the same reason that the actual sum of the bond leakage and the ballast leakage currents is less than their arithmetical sum, that is because of their being out of phase, due to the reactive component of the bond impedance, so the drop in voltage over the rails is less than the arithmetical sum of the drops due to the two leakage currents. The two currents will have the greatest phase displacement when the reactive component of the impedance of the band bears the greatest ratio to the ohmic component.

To sum up then, to keep down the power consumption for the signal system the bond should have low resistance, low iron losses and high reactance, or in other words, if the bond is energized with alternating current and properly connected with a ammeter, voltmeter, and wattmeter, it is desirable that the quotient obtained by dividing the volts by the amperes should be as large, and the watts as small, as possible. In this test the voltage should be the same as that to be used in service.

In addition to the reasons already mentioned, there are two others why it is desirable that the ohmic resistance of the bond should be low. Resistance is one of the factors in determining the temperature rise of the bond due to the flow of the propulsion current. It is also a factor in determining the value of the propulsion current voltage to which the relay is subjected when "unbalancing" exists.

Suppose in Fig. 1 the resistance of the two parts of the bond winding from A to B and A to C to be 0.0002 ohm each and that 2000 amperes are flowing in each rail. Then as the watts lost by a current flowing in a conductor are equal to the square of the current multiplied by the resistance of the conductor, the watts lost in the bond and connections due to the propulsion current, will be $2 \times \frac{2}{1000} \times 0.0002 = 1600$, or a little over two horse-power.

This loss shows itself in the form of heat, and the radiating surface of the bond should be sufficient to keep the temperature rise down to a point below that at which the insulating materials used in the bond begin to deteriorate.

As a rule this point is much higher than for most electrical apparatus.

Whether or not the capitalization of the loss would war rant the use of a larger size of copper depends on the cost of the propulsion current.

There is another important result due to unbalancing.

Supposing in Fig. 5 that unbalancing exists to the extent that 2500 amperes are flowing from A to B and 1500 amperes from A to C, then if the resistances from A to B and A to C are each 0.0002 ohm, the voltage drop from A to B is C $\times$ R or $2500 \times 0.0002 = 0.5$ volt. From A to C the drop is $1500 \times 0.0002 = 0.3$ volt.

The difference between these two drops, i. e., 0.2 volt, is the voltage across the rails, due to the unbalanced propulsion current, tending to cause the propulsion current to flow through the windings of the relay or transformer connected to the rails at that point.

It is easily seen from these examples that while resistance in the winding of the inductive bond is objectionable, its effects can be predetermined and allowed for in the design and selection of both the bond itself and the related apparatus. The exact value of the resistance to be used can be decided on when its various effects on cost and operation have been considered.

For the electric railway engineer direct current inductive bonds have at first thought just one point of interest, i. e., circular mils. This is because he always thinks first of the cross sectional area of his rail joint bonds.

What he is really interested in is the resistance introduced by the inductive bond in the return path of the propulsion current, and this resistance depends upon the length of the winding of the bond as well as on its cross section.

Furthermore, the inductive bond may be used only once in a mile of track, while the rail joint bonds occur every rail length, so it is at once apparent that so far as the electric railway engineer is concerned, the winding of the inductive bond may have a much smaller cross section and a much higher resistance than the rail joint bonds, and nevertheless introduce only a small percentage increase in the resistance of the return path of the propulsion current.

What has been said so far concerning reactance bonds has been said with the bonds in mind which are used on D. C. electric roads. The same principles apply in the case of the bonds for A. C. propulsion roads except in the case of unbalancing.

The trolley voltages used with A. C. propulsion are much higher than with D. C. propulsion, and the propulsion current is correspondingly lower. For instance, where 2000 amperes per rail were assumed in a previous example, supposing 500 volt D. C. propulsion, for 11,000 volt A. C. propulsion the current would be, say 100 amperes per rail.

It is at once apparent that the heat generated in the bond by the A. C. propulsion current will be much less than with the D. C. current with a given resistance of winding.

The A. C. propulsion current being small, a given percent-

age of allowable unbalancing means also a small actual value of unbalanced current to be provided for.

Now, the most common cause of unbalancing, i. e., the introduction of resistance in one side of the rail circuit by poor bonding, is common to both A. C. and D. C. propulsion. The effect of resistance in the two cases is different, however. With the D. C. current, doubling the resistance of one side of the rail circuit would mean that one-half as much propulsion would flow on that side as the other, and we would have 33⅓ per cent unbalancing.

The impedance offered by the rails to the flow of the A. C. propulsion current consists of both resistance and reactance however, and the resistance component is larger than the resistance offered by the rails to direct current because the alternating current tends to flow through the shell of the rail. Therefore, if we introduce the resistance, say a poorly-bonded joint which caused an unbalancing of thirty per cent with direct current propulsion, the unbalancing will be about eight per cent with the 25 cycle propulsion, neglecting the transformer action of the bond.

The fact that the unbalanced currents to be provided against with A. C. propulsion, are so much smaller than with D. C. propulsion, is very fortunate, on account of the transformer action which takes place in the bond when unbalancing occurs.

Referring to Fig. 5 it will be remembered that with equal amounts of current flowing through the two halves of the winding there is no magnetic effect on the core of the bond. With unequal amounts of direct current flowing it was shown that the core became magnetized, and a difference of D. C. potential appeared across the terminals of the bond equal to the value of the unbalanced current in amperes multiplied by the resistance from the middle of the bond to the rail.

With the unbalanced alternating propulsion current the difference of potential appearing across the rails, due to the propulsion current flowing through one-half the winding of the bond would be small, if the resistance only were considered, for we have shown that the amount of the unbalanced current against which it is necessary to provide is small. We have, however, shown that it is very desirable to have a bond of high reactance to keep down the leakage from rail to rail of the signaling current. But the flow of the unbalanced alternating propulsion current is also opposed by the reactance and we have a potential set up between the middle part of the bond and the rail, the value of which is proportional to the frequency and amount of the unbalanced current, and the reactance of the bond.

Moreover, as the magnetic circuit of the bond is common to both halves of the bond winding, the other half of the winding will act like a secondary to the first, and we will get twice the potential across the rails which is developed by the unbalanced propulsion current flowing through one-half of the bond wiring. It is seen, therefore, that when the reactance of a bond for A. C. propulsion is increased to reduce the leak of the signaling current, the selective track relay must be able to take care of a correspondingly higher value of the potential across the rails due to unbalanced propulsion current.

Track Relays.

Fig. 6 illustrates one way in which a relay on a steam road may be subjected to the influence of foreign or stray current. A steam road is shown paralleling an electric road for a short distance and finally running into the town where the power for the electric road is generated. The return current from the electric road passes on to the steam road rails, and back over them by way of ground and pipes to the negative side of the propulsion generator. In so doing it may pass through the steam road relay.

In the same manner Fig. 7 shows how a track relay on what has become known as a single rail track circuit of an electric road, may be subjected to the influence of the propulsion current.

Fig. 5 shows the same thing for what is known as the double rail track circuit for an electric road where unequal amounts of propulsion current are flowing in the two rails because of a defective electrical joint, say at the terminals of one of the inductive bonds or at a rail joint. In Fig. 5 the amount of foreign current voltage to which the track relay will be subjected will be extremely variable, and dependent on such unknown and variable quantities as the resistances of the various paths through which the current flows.

In Fig. 6 the amount of foreign current voltage to which the track relay circuit will be subjected can easily be ascertained, and increased for estimating purposes to represent any condition of bad track bonding desired. Its value is the resistance of the continuous rail between points A and C multiplied by the maximum amount of propulsion current which can flow between A and C. The value of the voltage due to the propulsion current which will exist across the terminals of the track relay, will bear the same proportion to the propulsion current voltage between points A and C as the resistance measured across the terminals of the relay bears to the resistance between A and C by way of B. Where the relay is shunted by a coil to divert the propulsion current, the resistance measured across the terminals of the relay is of course the parallel resistance of relay and shunt.

In Fig. 5 the propulsion voltage which would exist across the rails at the inductive bond, when unbalancing exists, has been discussed in detail under reactance bonds.

Having determined the voltage due to the propulsion current to which the track relay may be subjected in service, this voltage should be applied to the track winding of the relay being considered and the effect on the speed of action of the relay and on its temperature rise noted. The lattter should be well below the point causing any binding due to expansion, and below the point at which the insulation would soften on the hottest summer day.

If the relay has two energizing windings the effect should also be tried of short circuiting the terminals of the track winding and setting the moving element in various positions both with the other winding open and with it energized to various degrees with the frequency of alternating current which it is proposed to use.

Where the relay is designed to give protection against broken down insulated joints, the track winding should also be subjected to a voltage differing in phase from that normally supplied, by the smallest amount which could occur in practice. Under these conditions the contacts should of course open. The relation of the pick-up and drop-away voltages should be tested for mechanical reasons.

Transformers.

The selection of transformers for signaling purposes should comprise a consideration (in addition to that of cost) of insulation, regulation, and efficiency.

The insulation should be equal to that of the transformers of the best manufacturers. The ground shield is probably desirable for the same reasons as the grounded secondary of the commercial transformer for which it is a substitute. The regulation of a commercial transformer pertains to the change in secondary voltage which takes place between full load and no load. A signal transformer generally has two or more secondaries. Its load generally consists of a constant part and a variable part, the latter being due in most cases to changes in load on track secondary or secondaries due, for instance, to the presence or absence of a train on the track circuit, and to the operation of the signal motor.

The voltage variation to which the connected apparatus may be subjected being less, therefore, than that which occurs on going from full load to no load, the signal engineer should from his track circuit plan determine for each secondary the conditions which give the maximum and minimum loads on the transformer coincidentally with the maximum and minimum load on any secondary, and specify the voltage variation allowable on that secondary for those conditions.

As regards efficiency, the customer should know the losses in his transformer in order to determine whether or not their capitalization indicates any change of conditions, either in his system or in the transformer, which would insure an ultimate saving. The losses which occur in the transformer when carrying its prevailing load should of course be the determining factor, and not the losses occurring when the signals are clearing or the track circuit occupied, if this occurs but seldom.

The losses occurring under these latter conditions should be given due weight, however.

When a transformer serves the double function of supplying current, and also regulating the amount of current under short circuit conditions, the transfomer losses should be credited with the losses which would be entailed if some other means of regulating the current were used.

Signal Motors.

The choice of the motor for the signal is influenced by very much the same considerations as for other purposes except that the actual efficiency of the motor, i. e., the ratio of watts input to watts output, is a negligible factor in the energy consumption of a signaling system, since the total energy consumed in clearing the signals is relatively negligible. That is to say, if we are considering steam road conditions, where the power taken by the signal motor is, relatively, of the most consequence, the track circuit, slot, lamp, and transformer losses will probably take an amount of power which at three cents a kilowatt hour would cost a trifle over five cents a day, while the cost of power for fifty operations of the signal, even by a single phase induction motor, would not be over 0.04 of a cent, or less than one per cent of the total power.

The apparent efficiency of the motor, i. e., the ratio of

apparent watts input to the actual watts output, is of interest in but two ways: First, as affecting the increase of the normal supply of current to the signal system in case it has been interrupted, and it is necessary to clear all signals at once (and even here it is seldom of much importance if the transformers on the system have been provided with taps for taking care of normal line drop). Second, as affecting feasibility of distant signal control without the use of line relays.

As regards commutator motors versus induction motors, the balance as regards reliability and ease of maintenance will probably, as in the industrial field, work out in favor of the induction motor. With the single phase induction motor, increased economy gained by phase splitting devices involving contracts, should only be chosen after a full consideration of the degree of reliability likely to be sacrificed.

For signals having a low ratio of gearing, the commutator motor becomes almost a necessity on account of the high torque which it is necessary to develop, the current consumption of the induction motor being, comparatively, almost prohibitive for this condition, unless possibly an exception might be made of the polyphase induction motor. For signals with a high ratio of gearing either a commutator or induction motor has suitable torque characteristics.

Having decided on the lowest voltage at the terminals of the motor at which it will be required to operate, the motor should be tested in the signal with the spectacle, roundels, blade, up and down rod, or other parts with which it is to be used. With the semaphore and connected mechanism in the stop and caution positions it should be ascertained if the application of the minimum allowable voltage decided upon will clear the signal with the voltage maintained constant.

Another test should be made by bringing the motor to a full stop at about every five degrees of the stroke by lowering the voltage. The voltage should be raised after each stop to determine the minimum voltage at which the motor will clear the signal at that position. This series of readings will show the voltage at which the motor will clear the signal from any position.

Discussion on the Selection of Alternating Current Apparatus.

Mr. Balliet: I think this is a good time for Mr. Howard to bring up this question of inductive bonds, for the purpose of harmonizing our literature and keeping things straight.

Mr. Howard: I would be perfectly willing to accept the term "impedance bond." The term would be truly descriptive, and would also offer a description of the action of the bond. It is a word which everybody understands. If you impede anything you hinder it, and the bond impedes the flow of the signaling current.

Mr. Balliet: That is practically the term the committee has accepted, but we are going to eliminate "inductive."

Mr. Hawkins: Mr. Howard's paper refers to track relays of the two-windings of type. I should like to ask Mr. Howard whether he has any recommendations to make in regard to the use of the two-winding relay as compared with the one-winding relay. In my opinion the two-winding relay possesses two advantages over the one-winding relay for track circuit work; first, efficiency, since the greater part of the energy required for operating the relay is to be supplied directly instead of through the track circuit; and second, it offers complete protection against broken-down insulated joints without any special connections, which have certain disadvantages. I cannot agree with Mr. Howard that the use of a transformer ground shield is desirable. In the first place a ground shield occupies a valuable place for the transformer, and decreases its reliability. If no ground shield is present, a breakdown cannot take place through the two weakest points. The only reason for the use of a ground shield is to protect the low-voltage or secondary lines from the high or primary voltage. But the ground shield does not give complete protection against such a contingency, but does protect against a breakdown.

Mr. Howard: No doubt after you get it to a certain length of track circuit you can work more efficiently with the relay with the two windings. With the two-winding relay, economy of power consumption is obtained by putting most of the energy into the line or local winding, and very little into the track winding. All the power that goes into the track winding of the relay has to be transmitted over the rails, and a consequent rise in voltage takes place towards the transformer, resulting in consequent loss of power in the rails themselves and in leakage through the ballast, so it is preferable to keep down the energy you put into the track winding relay, and the more you have to transmit over the rails, the greater the rise of the voltage. If you can make a relay with a single winding, so that it will take less power than the local winding relay with two windings, up to a certain length of track circuit, it is advisable for many reasons to use the relay with the single winding. In using short track circuits the train entering the circuit whose transformer is holding the succeeding signal clear through the broken down insulation joint, will shunt the transformer and put the signal to danger, as it should be, exactly the same as is the case with the standard direct-current relays, which are in use everywhere on steam railroads. So that the danger from this source may be less than with relays of two windings. Now as to the ground shields, I am with the last speaker from the manufacturers" point of view. From the point of view of the maintainer, who may be on the pole working on the transformer, however, I fail to see why he is not given the much greater degree of protection, that he would have when a plate of copper is placed between the primary and secondary windings, and this plate of copper is properly grounded, than he would have if no ground shield were used.

Mr. Howard: I wanted to take up the question of the expediency of using the ground shield, as it was referred to, with the inference that this was accompanied by a decrease in the insulation used. I did not mean to imply that that was my idea of a ground shield. We use as high insulation with the ground shield as we do without it. But I fail to see how, if you have a shield of copper between two coils, and the copper is grounded, a man is going to get a shock from that transformer by the high-voltage current passing out of the primary windings into the secondary windings when it has got to go through the copper plate to do it.

Mr. Rhea: I would like to ask Mr. Howard whether or not in the event of a broken-down joint and a train in the block ahead and a train coming in the second block with a broken rail, the signal will stand clear, It certainly will under those conditions. There are two combinations that happen simultaneously, that will give you a clear signal.

Mr. Waldron: Where is the broken rail?

Mr. Rhea: In the second block back we will say.

Mr. Waldron: Back of the insulated joint?

Mr. Rhea: Yes, sir.

Mr. Rhea: Mr. Howard mentions the test for the double-winding relay. Are there any tests necessary for a single-winding relay?

Mr. Howard: A single-winding relay should be subjected to the influence of a direct current as well as a double-winding relay.

Mr. Waldron: What will be the difference in cost of insulation in the track circuit between single and double-winding?

Mr. Howard: It depends on the arrangement of the signals. It would be the difference of cost between single and double-winding relay, and you are working on high-tension lines. I do not think it would cost $200.00 to do that.

After the discussion of Mr. Howard's paper, a vote of thanks was given him by the association, and the meeting adjourned.

RESULTS OF LETTER BALLOTS.

The reports which were presented at the annual meeting of the Railway Signal Association at Richmond, Va., in October, 1910, and ordered submitted to letter ballot, have been voted on by the members of the association with the following results:

The report of the committee on Signal Practice and Standards, recommending that the Railway Signal Association, while not condemning upper left hand quadrant signals, should recommend the use of upper right-hand quadrant signals for new work and renewals, was adopted.

The semaphore spectacles, 1040, design "A," and 1041, design "B," shown on pages 284 and 285 of the 1910 Journal of Proceedings (all references are to bound Volume No. 7 of the Railway Signal Asscciation Proceedings for 1910), were adopted by a substantial majority. The spectacle rings (1042), ladders and ground masts (1026), ladder clamps and stays (1029), ground signal masts (1035), base for bracket and bridge signal masts (1036), bracket posts and bridge signal masts (1037), lamp bracket (1049), pinnacles (1050 and (1051), ladder foundation (1052), terminal block (1055B), nut and washer for binding posts (1070B), concrete foundation (1080), semaphore lamp and specifications (1100B) and lamp equipment (1101) were adopted. The diagrams of signal aspects (1045A and 1046A) failed of adoption. These standards are shown on pages 286 to 288, and 290 to 303, inclusive, of the Journal for 1910.

There was a tentative vote on the question of standard size for the lens of semaphore lamp No. 1100B, according to the resolution presented by J. C. Mock at the annual meeting in October, 1910 (page 330, Vol. 7.) This expression of opinion showed 155 votes for the 5 inch, 187 for the 5⅜

inch, one for the 5½ inch, 18 for the 6¾ inch, 20 for the 6½ inch and one for the 8⅝ in diameter. The tentative vote on the recommendations and specifications for one-inch signal pipe (pages 331 to 333, Vol. 7) stood 290 to 67 for adoption.

The Committee on Mechanical Interlocking recommended the use of pipe-connected home signals at points where the automatic return to normal position is not required, exact locations where special conditions exist, where the installation, maintenance and efficiency of operation make the power type preferable, and the use of power-operated signals at mechanical interlocking plants at points where three-position signals are required to return to the stop or caution position automatically, and at all points where three-position automatic block signals are now in use or are contemplated (page 225, Vol. 7). These were adopted, as were also a number of changes in the wording of general and detail specifications and the recommendation for using the electric lock to prevent a return of the home signal lever latch to normal position except when the circuit is completed through springs on the distant signal in its normal position (pages 223 to 228, Vol. 7).

The specifications for D. C. low-voltage motor semaphore signals (pages 349 to 355, Vol. 7), tinned channel pins (365 to 358), wood trunking (362 and 363), and caustic soda primary battery cell (1053D, pages 359 to 361), were adopted.

The revised specifications for double-braided, weather-proof, hard-drawn copper line wire; rubber-insulated, signal wire; galvanized E. B. B. iron bond wires; double-braided, weather-proof, galvanized B. B. iron line wire; aerial, braided cables; rubber-insulated, lead-covered, armored, submarine cable; and double-braided, weather-proof, hard-drawn, copper clad, steel wire, were adopted (pages 466 to 490, Vol. 7); as were also a form of wire inspection report, and a revised table of stranded conductors and flexible conductors for cables (pages 465 and 466, Vol. 7).

The definitions of the terms "blade-grip" and "blade," as submitted by Committee No. 7 on Subjects and Definitions (page 460, Vol 7), were favorably received and adopted.

The requisites and adjuncts submitted by Committee No. 6 on Automatic Stops and Cab Signals (pages 450 to 455, Vol. 7), were adopted, and the conclusion of the committee that the requisites of installation and the desirable characteristics embodied in this report form an adequate basis on which to design and construct a system of automatic stops and cab signals was adopted by a majority of 41 over the required two-thirds.

The Chicago & Northwestern is planning the installation of considerable single-track automatic block signaling during this season, and the system of operation probably will call for an arrangement of signals and overlaps similar to that recently put in service on the Northern Pacific.

The Chicago, Rock Island & Pacific is installing three-position upper-quadrant automatic block signals on its South Chicago line, 3½ miles of double track between Gresham and Stony Island avenue, Chicago, Ill. The installation provides for alternating-current operation of the signal system. The construction work is nearly completed, and the signals will be put in service in the near future.

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Folley, E., Asst. Sig. Supr., C. & E. I. R. R., 419 Anderson St., Danville, Ill.

Fossett, H. C., Supr. Sigs., C. & O. Ry., Covington, Ky.

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Hobson, Harry, Sig. Supr., A., T. & S. F. R. R., Topeka, Kan.
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Rainey, P. A., Asst. Sig. Supr., P. R. R., Harrisburg, Pa.
Rice, D. S., Sig. Supr., L. V. R. R., Geneva, N. Y.
Richards, B. H., Supt. Const., Sig. Dept., C., R. I. & P. Ry., care of A. G. Shaver, La Salle St. Station, Chicago, Ill.
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Seifert, A. J., C., R. I. & P. Ry., Chicago.
Shatwell, E. V., Sig. Inspr., C. & N. W. Ry., West Chicago, Ill.
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Steven, Alex., Sig. Supt., Caledonian Ry., 87 Union St., Glasgow, Scotland.
Stradling, E. G., Sig. Inspr., C. I. & L. Ry., Salem St. Office, Lafayette, Ind.
Stuart, F. C., Director, Sig. Engr., Sunset Route, Houston, Texas.
Towle, Harry S., Gen. Sig. Inspr., Erie R. R., 130 Jackson St., Passaic, N. J.
Tracey, Chas., Supt. Sigs., I. C. R. R., Dubuque, Ia.
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Whitcomb, L. L., Supr. Sigs., L. S. & M. S. Ry., Elyria, O.
Wiegand, C. H., Supr. Sigs., N. Y. C. & H. R. R., Spuyten Duyvil, N. Y.
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Zane, Wm. F., Chief Draftsman, Sig. Dept., C., B. & Q. R. R., 209 Adams St., Chicago, Ill.

JUNIOR MEMBERS.

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Hyder, J. D., Sig. Repairman, care of N. C. & St. L. Ry., Chattanooga, Tenn.
Kellenberger, K. E., Sig. Inspr., C. & N. W. Ry., 2027 Harrison St., Evanston, Ill.
Love, L. J., Sig. Repairman, Penna. Lines West, 415 N. Cherry St., Canton, O.

ASSOCIATE MEMBERS.

Ames, Azel, Kerite Ins. Wire & Cable Co., 30 Church St., New York.
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Baird, R. I., Salesman, The Electric Storage Battery Co., Marquette Bldg., Chicago, Ill.

Banks, W. C., Pres. and Mgr., Banks Electric & Mfg. Co., 200th St. and Webster Ave., New York, N. Y.
Beck, H. M., Engr., Electric Storage Battery Co., 1400 Association Bldg., Chicago, Ill.
Bliss, E. F., Railway Sig. Engr. Dept., General Electric Co., Schenectady, N. Y.
Brach, Leon St. Clair, Pres., L. S. Brach Supply Co., 143 Liberty St., New York, N. Y.
Brixey, Richard, Pres., Kerite Ins. Wire & Cable Co., 30 Church St., New York, N. Y.
Brown, E. W., Salesman, Edison Mfg. Co., 34 Cambridge Ave., East Orange, N. J.
Cameron, F. C., Corning Glass Works, Corning, N. Y.
Camp, W. M., Editor, Railway Review, Manhattan Bldg., Chicago, Ill.
Cook, W. J., Pres., Cook Railway Signal Co., 1067 Gas & Electric Bldg., Denver, Col.
Cook, W. L., U. S. Electric Co., Chicago, Ill.
Corey, F. B., General Electric Co., Railway Sig. Dept., Schenectady, N. Y.
Delavie, F. J., Mgr., Bat. Zinc Dept., Grasselli Chem. Co., Cleveland, O.
Ferguson, H. K., Railway Sig. Dept., General Elec. Co., 631 Rugby Road, Schenectady, N. Y.
Foster, W. E., Ingalls-Shephard Forging Co., McCormick Bldg., Chicago, Ill.
Gifford, H. E., care of American Conduit Co., East Chicago, Ind.
Hall, G. L., Vice-Pres., Q. & C. Co., 90 West St., New York, N. Y.
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Hudson, E. E., Mgr. Sales, Primary Battery Dept., Edison Mfg. Co., Orange, N. J.
Hulmes, W. A., Gen. Ry. Signal Co., Chicago, Ill.
Johnson, Sidney, Gen. Sales Mgr., Union Switch & Signal Co., 30 Church St., New York, N. Y.
Langdon, J. L., General Railway Signal Co., Rochester, N. Y.
Lepreau, F. J., Edison Mfg. Co., 304 Wabash Ave., Chicago, Ill.
Lorenz, J. M., Salesman, Central Electric Co., 270 5th Ave., Chicago, Ill.
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Marshall, Edw. L., Chem. Engr., National Carbon Co., 118 S. Wood St., Freemont, O.
Moore, A. G., Ry. Sig. Dept., General Electric Co., Schenectady, N. Y.
Moore, P. W., Gen. Mgr. P. & M. Co., Chicago, Ill.
Murphy, John, Elec. Engr., Dept. Railways and Canals, 174 Maclaren St., Ottawa, Canada.
Piper, H. L., Hiram L. Piper Co., Ltd., 17 Normand St., Montreal, Can.
Poor, C. O., Gen. Supt., General Railway Signal Co., Rochester, N. Y.
Smith, F. C., American Conduit Co., East Chicago, Ill.
Sperry, H. M., Sales Mgr., General Railway Signal Co., Rochester, N. Y. P. O. Box 1052.
Thompson, A., Jr., General Railway Signal Co., Rochester, N. Y.
Thompson, H. G., Mgr., R. R. Dept., Edison Storage Battery Co., Orange, N. J.
Weld, Harold K., Asst. Sales Rep., McRoy Clay Works, The Rookery, Chicago, Ill.
White, F. J., Salesman, The Okonite Co., 253 Broadway, New York, N. Y.
Workman, W. S., General Ry. Signal Co., 129 Hobart St., Rochester, N. Y.

RAILWAY APPLIANCES ASSOCIATION.

At the last annual meeting of the Road and Track Supply Association, the name was changed to Railway Appliances Association.

In the Daily Railway Age Gazette of March 15, 1910, page 560, there appeared an article which outlined the work of the Road and Track Supply Association from its inception in 1894. We print herewith pictures of the officers and members of the executive committee elected in March last.

The president of the association, T. W. Snow, who, until a month ago was president of the Otto Gas Engine Works, is now making a specialty of water appliances and coaling stations for railways. His identity with the railway supply business dates back to 1878, when he entered the employ of the Pennsylvania Steel Company, under George W. Parsons, then superintendent of the frog, switch and signal departments. Ten years later Mr. Snow was appointed assistant general agent of the United States Wind Engine & Pump Company at Batavia, Ill., and he devoted most of the next ten years to building waterworks plants for villages, towns and railways. From the end of 1898 until his election to the presidency of the company in 1906, Mr. Snow was manager of the western branch of the Otto Gas Engine Works at Chicago.

T. W. Snow.
President.

Robert E. Belknap, the vice-president of the association, is Chicago sales agent for the Pennsylvania Steel Company and Maryland Steel Company. His connection with railway work dates back to 1898, when he was engaged in building the Eighth avenue and Sixth avenue underground trolley conduits for the Metropolitan Street Railway, New York City, as assistant to the engineer for the National Contracting Company. In 1901 he joined the sales force of the Pennsylvania Steel Company, and Maryland Steel Company and after working in all the different departments, especially the rail, frog and switch departments, billet mill, steel foundry and bridge shop, and the forging, machine and marine departments, he was attached to the general sales office at Steelton. In July, 1902, Mr. Belknap was transferred to the new Chicago sales office as assistant sales agent and western representative, and in 1906 was made sales agent.

Robert E. Belknap.
Vice-President.

Both Mr. Snow and Mr. Belknap were elected members of the executive committee in 1908.

The secretary and treasurer, John N. Reynolds, whose pic-

Azel Ames.

A. P. Van Schaick.

W. F. Schleiter.

George Stanton.

John McKinnon.

T. R. Wyles.

John N. Reynolds,
Secretary-Treasurer.

George C. Isbester.

OFFICERS AND EXECUTIVE COMMITTEE OF THE RAILWAY APPLIANCES ASSOCIATION.

ture appears on the page preceding, is western manager of the Railway Age Gazette.

The other members of the executive committee are: John McKinnon, secretary and general manager, Kalamazoo Railway Supply Company, Kalamazoo, Mich.; George Stanton, sales agent, Cleveland Frog & Crossing Company, Cleveland, Ohio; W. F. Schleiter (ex-officio), secretary, Dilworth, Porter & Company, Pittsburgh, Pa.; A. P. Van Schaick, Lackawanna Steel Company, Chicago; Maj. Azel Ames, in charge of railway department, Kerite Insulated Wire & Cable Company, New York; T. R. Wyles, vice-president, Detroit Graphite Company, Chicago, and George C. Isbester, vice-president, Q. & C. Company, Chicago.

REPAIRS TO THE LA SALLE STREET STATION TRAIN SHED ROOF, CHICAGO.

Extensive repairs, made necessary by the deterioration of the concrete in the slabs, have just been completed on the train shed roof of the La Salle Street Station, Chicago.

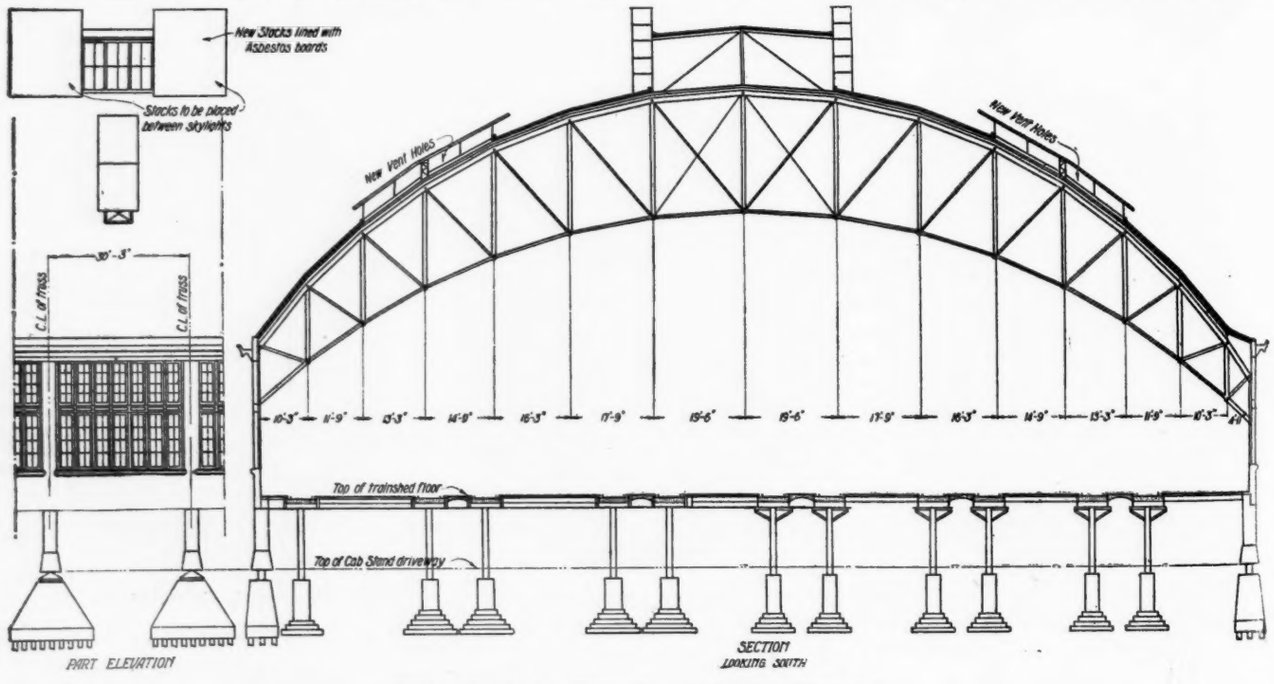
When the roof of the train shed of the La Salle street station, Chicago, was first built the steel framework was covered with cinder concrete slabs reinforced with No. 10 expanded metal having about a 3-in. mesh. These slabs were covered on the outside with a shell of cement and sand concrete about ¾ in. thick. The roof surface of the train shed was broken up into vertical panels by the use of molded wooden strips of an irregular shape but approximating a 4-in. x 6-in. section, spaced 2 ft. 6 in. between centers, the idea of the wood ribs being to break the monotony of the flat surface and to take care of expansion. The roofing used was the H. W. Johns-Manville Company (New York), special Manville brand of asbestos roofing, which was put on vertically and turned up against the sides of the ribs, the edges being cemented to these ribs. A cap of this same material was then put over the vertical ribs and securely nailed with copper nails, after which the whole surface was mopped with a special asphalt roofing coating.

In the original application and fastening of these ribs there was a tendency to crack the concrete shell, allowing some moisture to get in from the top. The fumes and the exhaust steam from the engines penetrated this thin shell, and, coming in contact with the cinders which contained more or less unslacked coal, produced a chemical action which in many cases reduced the steel to absolute rust. This steel, when it began to corrode, expanded and cracked the lower shell, allowing further gases and moisture to penetrate the slab from below.

The first warning that such an action was taking place was given when a piece of the lower shell, about 18 in. square, fell, taking with it a piece of reinforcement which was entirely disintegrated along the edges of this piece. A very thorough examination of the roof was then made by a bridge erecting gang, and it was decided to renew the upper or flat portion of the dome. When the roof was opened up, however, and a more careful examination of the lower portions could be made, it was decided to remove the entire roof covering.

The sides of the original dome were dotted about every 60 ft. with glass dormer skylights, which, being flat on top, simply formed pockets for the gases to accumulate. In these portions of the roof the steel framework was almost entirely eaten out and the copper bars forming the framework for the glass were eaten entirely through in many places. There had also been some sloping skylights along the monitor between the slat louvres. In making repairs to the roof these skylight dormers and sloping skylights were eliminated and permanent sash put in on the monitors. Long vertical hooded slots were put in on each side to allow the fumes and exhaust from the engines to get out of the shed more quickly, where originally all these gases had to travel up the dome of the roof to the monitor to escape. At the north end of the shed five large stacks of steel framework covered with asbestos board were also built to facilitate the escape of these gases.

In making the new slabs a rich concrete of one part Portland cement, two parts torpedo sand and four parts fine crushed stone were used, except on the outside edges, where a 1 to 1 mixture was put in, a woven wire reinforcement being used. Special care was taken in the construction of the frames so that the slabs were of exact dimensions. While drying, the slabs were stacked in the yard with air spaces between them and they were constantly sprinkled while setting. They were waterproofed on all sides by the use of ironite. The slabs were originally designed with four hook bolts, one at each corner to secure them to the iron framework of the roof, but on account of the slot which it was necessary to leave in the slab to receive



Train Shed; La Salle Street Station, Chicago.

the nut weakening the corner and making it liable to crack, the number of bolts was reduced to two for each slab. Small wooden blocks were also inserted in the concrete to facilitate nailing to the vertical wooden ribs. The joints between the slabs were filled with Portland cement mortar and the roofing used was the same as that on the original roof. Some 9,000 slabs, each 2 ft. wide by 5 ft. long and 2½ in. thick were required for this work.

We are indebted for this information to A. T. Hawk, architect of the Chicago, Rock Island & Pacific, under whose direction this work was done.

THE EXHIBIT.

With several thousand invitations out to the officers of railways, to presidents, general managers, superintendents and chief engineers, to come or send their subordinates to see the show at the Coliseum, it devolved on the management of the exhibit to make good and produce something that would come up to the expectations that so lavish a summons warranted. That these expectations have been more than met cannot fail to be the testimony of any visitor, whether it be as a mere lay observer to whom the mass of black and colored objects in their multitude of forms is a meaningless aggregation, or as a student and expert to whom it represents, what it really is, a collection of the latest and best in the development of track and roadbed and the appliances for the most economical methods of their construction and maintenance, as well as those for insuring the greatest safety in the conduct of transportation.

In a case like this, where the same parties are responsible for the results, comparisons cease to be odious, but become the natural method of showing growth and development. So, if we recollect what was done a year ago, excellent as was the impression produced, we at once see that there has not only been a great improvement in the general aspect of the show, but that manufacturers have reached a fuller realization of what it really means, and of what it is worth, and have come in greatly increased numbers to exhibit of their best and latest. Of the general appearance, taught by the experience of the past, there is a uniformity in the method of display and announcement that gives an air of harmony to the whole, which lends an artistic touch that is very pleasing to the eye.

It is impossible here to do more than indicate in the most cursory manner a few of the prominent characteristics of the display, without attempting any detailed description. Apparently it was desired to bring the signal exhibits to the fore, for immediately in front of the entrance and occupying the center of the building, there are four semaphore posts with their arms and attachments. This may have been mere chance, but surely the signal men have come well to the front in what they have to show. Some of it is acknowledgedly experimental and is shown with as much of a desire to sound the opinions of the members as to the desirability or advisability of certain changes, as with the expectation of their immediate adoption. Such a case is to be found in the arrangement for using a light indication for a day signal, instead of a semaphore. This was necessitated by some of the local conditions at the Pennsylvania terminal in New York, and the success attending the venture evidently led to this more advanced proposal. If any one thing could be said to be brought more to the front than another, it might be the use of the electric motor for the operation of signals and switches. The development from the old hand-operated devices has been very rapid during the past few years, until now the motor is accepted as a matter-of-course, and the makers have passed the point where it is necessary to argue the point with the engineer. One of the interesting features of signal operation will be found in the use of an automatic system of permissive blocking for a single track road. With this trains moving in the same direction may be admitted successively into a block between two passing sidings, while there is an absolute block against any movement in the opposite direction.

Closely allied with the signals are the exhibits of lamps for the various purposes demanded. Here, too, there are some novelties, as well as some very beautiful and artistic displays. The advance in the art of signaling has been paralleled with the care with which the lamps are designed and made. Not only is the mechanical work of the most substantial character, but we find that the lamp men have stopped buying lenses that were not designed, but "just growed" like Topsy, and are having them really designed for the purpose for which they are to be used. A casual inquiry from several of the exhibitors who were enlarging upon the value and effectiveness of their wares, as to "who designed the lenses," brought the prompt naming of one or two optical experts noted for their scientific attainments and their skill in the designing of this class of work. In this way manufacturers are putting out lamps that have not only a greater power of illumination, but are capable of throwing that illumination in all its intensity over a wider visual angle and so obtaining results that were not considered possible a few years ago.

But signals and lamps are not all that there are to be seen. There are many notable examples of track, switch and crossing construction, some of them old friends and many with a new wrinkle or improvement attached that adds to their value. In this the trend of the modern railway that looks for a substantial construction rather than a minimum of first cost is very apparent. This is particularly noticeable in the matter of derails. A few years ago, any old thing that would ditch a car was all that was required. It was something that must be cheap, but to-day we find that there are elaborate means of connecting the derails to the switch and interlocking movements, that the parts are made for service and endurance and that the insurance of their operative effectiveness is of as much importance as to have something that could be called a derail to show good intentions.

Then, there is a multiplicity of co-related objects: things that the chief engineer and his roadmasters must use and have for their daily work. If they wish to ride, it would be an exacting and carping official, indeed, who cannot find something in what is shown to carry him, his men or his tools to the point where work is to be done, or an inspection made. There is everything from the push-car and the rail wheelbarrow, to the elaborate gasolene-driven motor car with speed capabilities well up to the safety limit.

These are impressions of the show, but when it comes to the last analysis it would seem that nearly everything is there. The chief engineer can walk into the Coliseum and equip a party with transits, levels, rods, tapes, chains and all the paraphernalia for a survey, and then he can find derricks and excavators to do his grading; he can find ties and rails, and ballast and concrete and culvert pipe for the completion of the work, he can get spikes and joints to hold his rails; he can find barrows and mauls and shovels and picks for its maintenance; he can get poles for his wires, and wires that are bare, are copper covered, or insulated, to carry any sort of current that he wishes; he can bond or insulate or play any electrical trick that may please him, with his rails; he can build crossings and lay out sidings with the material ready to his hand; he can carry from the building the signals and interlocking that will make his road the model of efficiency and operation, and then he may add the externals that come within his province. He can erect his stations and roundhouses and warehouses, and may even harvest the ice that is to keep him cool in summer, or install the heating apparatus that is to keep out the winter's cold. In fact, there is little left for him to do beyond what he can

here find the means of accomplishing. And then, when he has gone through it all and absorbed as much as his brain can hold, he will be quite willing to acknowledge the truth of our opening statement as to the comprehensiveness of the exhibit and its value to any railway engineer who wishes to keep posted and know of what is latest and best in the matters pertaining to his department.

LIST OF EXHIBITORS.

The following is a complete list of all exhibits in place or being installed in the Coliseum yesterday (Monday) afternoon:

Adams & Westlake Company, Chicago, Ill.—Signal lamps, lanterns, railway specialties. Represented by Walter H. Baldwin, G. L. Walters, A. S. Anderson, C. B. Carson, W. J. Pierson, H. G. Turney, E. H. Stearns and Frank N. Grigg. Spaces 83-84.

Ajax Forge Company, Chicago, Ill.—Represented by F. G. Bradley, H. G. Elfborg and H. C. Hutchins. Spaces 195-196.

Alamo Manufacturing Company, Hillsdale, Mich.—Gasoline, gas, kerosene and distillate engines for railway service, pumping outfits, charging storage battery plants. Represented by L. A. Hopkins, J. L. Benedict, B. L. Winchell, Jr., R. A. Paterson, R. C. Bristol and Wm. Prideaux. Space 189.

Alexander Crossing Company, Clinton, Ill.—Continuous-rail non-pounding crossings. Represented by Louis Alexander, I N. Brown and Robert Johns. Spaces 199-200-213-214.

Allegheny Steel Company, Pittsburg, Pa.—O. H. steel plates, sheets, stamping steel, deep drawing steel, electrical sheets, "Reliance" steel and charcoal iron boiler tubes and locomotive flues, pipe, steel castings, stamped steel specialties, plate washers. Represented by T. G. Seixas and A. P. Scott. Spaces 244-245.

Allith Mfg. Company, Chicago, Ill.—Door hangers, approved fire door, warehouse door, continuous parallel door, merchandise carrier and rolling store ladder equipment. Represented by W. D. Jameson. Space 116.

American Concrete Pile and Pipe Company, Chicago, Ill.—Concrete culvert pipes and piles. Represented by S. W. Crocker and J. M. Watrous. Space 191.

American Guard Rail Fastener Company, Philadelphia, Pa.—Anchor guard rail clamps, tie-plate guard-rail fasteners and Vaughan automatic rail anchors. Represented by D. F. Vaughan and Chas. Z. Vaughan. Space 119.

American Hoist and Derrick Company, St. Paul, Minn.—Complete life-size "American Railroad Ditcher," mounted on flat car. Represented by F. J. Johnson, W. L. Manson and W. O. Washburn. Spaces 201-202-203.

American Rail Joint Company, Toronto, Ont.—"Reinforced angle bars." Represented by Thos. D. Beddoe. Space 253.

American Railway Signal Company, Cleveland, O.—Electric automatic signals, electric switch locks, electric dwarf signals, tower and switch indicators, relays and electric interlocking apparatus. Represented by G. L. Weiss, H. M. Abernethy, H. D. Abernethy and J. L. Burrows. Spaces 21-22.

American Railway Steel Tie Company, Harrisburg, Pa.—Section of track with their steel ties. Represented by John G. Snyder. Spaces 220-221.

American Steel and Wire Company, Chicago, Ill.—Right-of-way fencing, gates, signal wire, rail bonds, tie-marking nails. Represented by J. M. Holloway, L. P. Shanahan, S. F. Deems, H. A. Parks, B. H. Rider, H. S. Durant and C. S. Knight. Spaces 50-51-69-70.

American Valve and Meter Company, Cincinnati, O.—Poage automatic water columns, tank valves and fixtures, Fenner drop spout, Economy switch stands, Anderson interlocking switch stands and safety switch locks for main line switches, track devices. Represented by J. T. McGarry and F. C. Anderson. Spaces 130-131-132.

American Vulcanized Fiber Company, Wilmington, Del.—Original vulcanized fiber for rail joint insulation, steel tie insulation, mechanical use. Represented by John Barron. Space 136.

America Well Works, Chicago, Ill.—Deep well and centrifugal pumping machinery with any style of power, air compressors, well drilling and prospecting machinery. Represented by Geo. W. Igo, C. O. McLean and A. W. McLean. Spaces 14-15.

Armspear Mfg. Company, New York, N. Y.—Pressed steel switch lamps, one-day and long-time burners, semaphore and train order lamps, automatic classification and train markers, steel and wire guard lanterns. Represented by F. D. Spear, C. K. Freeman and F. A. Buckley. Space 184.

Asbestos Protected Metal Company, Canton, Mass.—Two sheets of asbestos protected metal. Represented by Wilmot W. Burritt. Spaces 78-97.

Asphalt Ready Roofing Company, New York, N. Y.—Protection brand asphalt roofing, sand and gravel surfaced, with 6-inch lap, which can be laid with no nails exposed on the outside; Arrow brand, sand and gravel surfaced roofing; Stonehenge, smooth surfaced roofing; Hudson brand asphalt felts. Represented by Harry H. Huested and A. Brewster Clark. Space 168.

Banks Electric and Mfg. Company, New York, N. Y.—Banks' signal batteries, Banks' track batteries. Represented by W. C. Banks, Geo. W. Davis and John H. Bush. Space 280.

Barrett Manufacturing Company, New York, N. Y.—Roofing, floor protection particularly adapted for wooden floors in repair shops and freight houses, bridge waterproofing, waterproofing and damproofing for masonry. Represented by L. P. Sibley, W. S. Babcock, H. B. Nichols and C. T. Bilyea. Space 106.

Bausch & Lomb Optical Company, Rochester, N. Y.—Engineering and surveying instruments, transits and levels, etc. Represented by W. Louis Johnson. Space 96.

Beaver Dam Malleable Iron Company, Beaver Dam, Wis.—Tie plates and rail braces. Represented by Lawrence Fitch, J. V. Cowling, F. S. McNamara, E. A. Hawks, W. L. Douglass and D. P. Lamoreaux. Spaces 165-166.

Blocki-Brennan Refining Company, Chicago, Ill.—Carboxide elastic metal preserver and some of the bi-products. Represented by W. F. Brennan and James C. Cleary. Space 261.

Bossert Mfg. Company, W. F., Utica, N. Y.—Triple-lock switch stand, Bossert insulated rail joint, Nickerson safety switch point lock, Bossert improved switch point adjuster, tie plate and guard rail clamp, semaphore blade clasps, Simplex and Duplex track drills. Represented by F. L. Guillaume, Wm. F. Bossert, H. C. Williams, R. E. King and Willis C. Squire. Space 118.

Bowser & Co., Inc., S. F., Fort Wayne, Ind.—Oil storage systems, self-measuring pumps for handling oils, gasoline, varnishes, etc. Represented by C. A. Dunkelberg, W. T. Simpson, F. T. Hyndman and E. H. Barnes. Space 186.

Bryant Zinc Company, Chicago, Ill.—Signal supplies, battery supplies, fiber conduit, Gould storage batteries, crossing bells, battery vaults and chutes, electrical instruments, track and linemen's tools. Represented by A. F. Klink, E. M. Deems, R. N. Baker, Stanley Bryant, H. J. Hovey, R. N. Chamberlain and J. W. Cremerius. Spaces 153-154-155-156.

Buda Company, Chicago, Ill.—Railroad motor cars and velocipedes, track drills, drill grinders, switch stands, ratchet jacks, ball-bearing jacks, adjustable switch rods, solid manganese crossing, replacers, electric crossing gates. Represented by H. K. Gilbert, L. M. Viles, Wm. P. Hunt, Jr., W. B. Paulson, J. T. Harahan, Jr., Geo. B. Shaw, L. Hamill, A. R. Dyer, J. J. Gard and H. S. Evans. Spaces 87-88-89-90.

Burroughs Railway Nut Lock Company, Jacksonville, Fla.—Positive railway nut lock. Represented by Oliver B. Burroughs and J. A. Agnew. Space 281.

Buyers' Index Company, Chicago, Ill.—Book, "Railway Supply Index-Catalogue and Purchasing Agents' Buying List." Represented by Lloyd Simonson, Horace E. Frame, Alexander Smith, D. J. Beaton and F. B. Cozzens. Space 190.

Cambria Steel Company, Johnstown, Pa.—Rails, 100 per cent. splice bars, Morrison guard rails, "Coffin Process" axles. Represented by J. L. Replogle, A. Morrison, C. J. Ellis, H. P. Hubbell and J. L. Adams. Space 177.

Carey Company, Philip, Cincinnati, O.—Roofing, asbestos and magnesia products, insulating materials. Represented by J. L. Morse, W. C. Ignatius, E. S. Main and Frank Carter. Space 170.

Carnegie Steel Company, Pittsburg, Pa.—Section of railroad track, constructed with steel cross ties and Duquesne joints, with various types of fastenings, including insulated wedge fastening; steel cross ties which have been in track since 1904, with information showing weight, service, etc.; light ties for portable track; assortment of Duquesne rail joints; large display of nickel-plated samples, showing representative shapes rolled by Carnegie Steel Company; steel sheet piling, U. S. and Friestedt; bolt and spike tests; steel freight car, engine truck, passenger car and street car wheels; bolt and spike kegs, showing steel hoops. Represented by N. M. Hench, Edwin S. Mills, C. B. Friday, Herbert VanZant, F. Rys, P. W. O'Brien, H. C. Griswold, Kent Porter and Robert Coe. Spaces 52-53-71-72.

Carpenter & Co., Geo. B., Chicago, Ill.—Cordage, cotton duck, tackle blocks, rubber goods, switch ropes, track tools. Represented by Henry W. d'Evers. Space 157.

Ceresit Waterproofing Company, Chicago, Ill.—Concrete and cement mortar slabs waterproofed with Ceresit subjected

to high water pressure, proving the water repelling qualities of Ceresit. Represented by P. H. Hansen. Space 262.

Chicago Bridge and Iron Works, Chicago, Ill.—Model of an all-steel water tank; pictures of bridges, retorts, steel coal chutes and tanks. Represented by Geo. T. Horton, H. B. Horton, M. J. Trees, E. G. Ladd, C. S. Pillsbury and E. W. Steinmueller. Space 176.

Chicago Pneumatic Tool Company, Chicago, Ill.—Section motor cars, pneumatic and electric tools. Represented by C. E. Walker, J. G. Osgood and C. B. Coates. Space 68.

Chicago Steel Tape Company, Chicago, Ill.—Implements for field surveys such as steel tapes, leveling rods, lining poles, marking pins, stadia rods, targets and repairing devices. Represented by L. A. Nichols and S. A. Holland. Space 113.

Cleveland Frog and Crossing Company, Cleveland, O.—"Hard Service" manganese frogs and crossings, improved spring rail clamps, interlocking switch appliances, etc. Represented by G. C. Lucas, Geo. Stanton, A. Peabody, L. G. Parker and Geo. Arnold, Jr. Spaces 102-103-104.

Collins & Co., W. P., Chicago, Ill.—Lubricating oils and greases, Kapak (Elaterite) paint, ready roofing, Lardoilene cutting compound. Represented by W. P. Collins, J. J. Collins, D. Risley, A. B. Cross, J. Roskilly and C. S. Kennerly. Space 282.

Concrete Form and Engine Company, Detroit, Mich.—Collapsible steel form for building concrete culverts, conduits, sewers, etc.; railroad velocipede equipped with Belle Isle gas engine; stationary engines for all purposes. Represented by W. C. Shanafelt, F. S. Freer, L. K. Rumsey and W. D. Waugh. Space 283.

Conley Frog and Switch Company, Memphis, Tenn.—Conley patent frogs, manganese frogs, railway track appliances. Represented by John E. Conley. Space 164.

Continuous Frog and Crossing Company, Reinforced Rail Joint Company, St. Louis, Mo.—Railroad frogs and rail joints. Represented by W. G. Brown. Space 219.

Cook's Standard Tool Company, Kalamazoo, Mich.—Standard bonding drills, Standard track and car jacks, Climax track drills, Magic tool grinders, Magic chucks and high speed bits. Represented by Eugene Cook and F. C. Butler. Space 115.

Crane Company, Chicago, Ill.—Cranetilt steam traps, motor operated steel gate valves, special valves for creosote and zinc-chloride, locomotive safety valves, brass valves, ammonia valves and fittings, cast and malleable iron fittings, Crane railroad ball joint unions and fittings and special fittings for steam, water, gas and air, especially recommended for railroad work. Represented by F. D. Fenn, F. C. Sabin and J. B. Jordan. Space 146.

Detroit Graphite Company, Detroit, Mich.—Paint for bridges, buildings, structural steel, etc. Represented by T. R. Wyles, L. D. Mitchell, Edwin Booth, A. H. Kuerst and B. O'F. Randolph. Space 77.

Detroit Steel Products Company, Detroit, Mich.—Solid steel Detroit-Fenestra windows. Represented by Chas. R. Ayars. Space 180.

Paul Dickinson, Inc., Chicago, Ill.—Cross sections of standard roundhouses showing various styles of buildings, latest designs in smoke jacks, cast-iron chimneys and ventilators. Represented by J. A. Meaden and A. J. Filkins. Space 86.

Eugene Dietzgen Company, Chicago, Ill.—A complete line of modern surveying instruments, leveling rods, ranging poles, tapes, rail profile machines and other supplies which are used by engineers both in the office and in the field. Represented by W. E. Cook, W. O. Phillips, G. C. Moore and C. S. Breckinridge. Space 2.

Dilworth, Porter & Co., Ltd., Pittsburg, Pa.—Railroad spikes and tie plates. Represented by W. F. Schleiter and Chas. Johnston. Space 26.

Dixon Crucible Company, Joseph, Jersey City, N. J.—Dixon's Silica-Graphite Paint. Graphite productions. Represented by H. W. Chase and E. R. Smith. Space 169.

Dressel Railway Lamp Works, New York, N. Y.—Switch, semaphore, tower, station, engine, tail-marker, caboose, crossing gate and water-trough lamps, oil pots, long-time and standard railroad lamp burners, etc. Represented by F. W. Dressel, Robert Black, H. S. Hoskinson, E. W. Hodgkins, A. P. Grenier B. P. Claiborne and F. E. Edmunds. Space 105.

Drouvé Company, G., Bridgeport, Conn.—"Anti-Pluvius" puttyless skylights and the "Lovell" and "Straight-Push" sash operators. Represented by William V. Dee, George J. Adam and R. S. Adam. Space 163.

Duplex Metals Company, Chester, Pa.—Miniature pole line showing results from heavy snowstorm; samples of all kinds of copper-clad steel wire and products, such as nails, cotter pins and bolts. Represented by Frank R. Chambers, Jr., Wm. T. Kyle, Geo. P. Fondersmith, W. W. Lampkin and E. M. Fondersmith. Spaces 38-39.

D. & A. Post Mold Company, Three Rivers, Mich.—"D. & A." cement post machines, molds, posts, reinforcements, car steam curing unit for posts; mold and reinforcement for concrete poles for telephone and telegraph service. The "Shaking System." Represented by G. H. Dougherty, O. Dougherty and L. R. Dougherty. Spaces 134-135.

Eastern Granite Roofing Company, New York, N. Y.—Granite roofing, Evertite crushed stone roofing, "Tisbest" smooth surface roofing, Palmoid smooth surface roofing. Represented by H. Henning, C. F. Barstow, A. E. Roever and A. W. Turner. Space 129.

Economy Separable Switch Point Company, Inc., Louisville, Ky.—"Economy" separable switch points, "Economy" adjustable head rods, "Economy" separable claw bar, "Economy" foot guard, positive rail anchors, positive rail anchor-tie plate combination, positive malleable tie plates. Represented by W. M. Mitchell, W. M. Mitchell, Jr., R. H. Johnson, Geo. A. Johnson and D. C. Byrne. Spaces 187-188.

Edison Mfg. Company, Orange, N. J.—Primary batteries for signal work, automatic block signals, crossing bells, telephone circuits and gas engine ignition. Represented by E. E. Hudson, E. J. Lepreau, E. W. Brown and P. A. Garrity. Space 151.

Edison Storage Battery Company, Orange, N. J.—Storage batteries of various types, portable and stationary, for railway signal application; car lighting and ignition batteries. Represented by H. G. Thompson. Space 152.

Edison, Thomas A., Inc., Orange, N. J.—Business phonographs. Represented by L. D. Dexheimer and E. B. Bostwick. Space 287.

Electric Storage Battery Company, Philadelphia, Pa.—"Chloride Accumulator" batteries for drawbridge operation, and Chloride, Tudor and Exide types for car lighting, electric interlocking plants and automatic block signal work; couple types for small lighting plants, telephone and telegraph service. Represented by G. H. Atkin, T. Milton, R. E. Baird and T. A. Cressey. Space 158.

Fairbanks, Morse & Co., Chicago, Ill.—Motor cars for section work and inspection, also for signal and telegraph departments; gasoline pumping engines, steam pumps, railroad pumping windmills, standpipes, gasoline and gas engine generating sets, motors and dynamos, track and bonding drills, ratchet, ball-bearing and hydraulic jacks, scales. Represented by S. F. Forbes, C. W. Kelly, A. A. Taylor, F. M. Condit, L. H. Matthews, E. M. Fisher, G. J. Akers, A. F. Young, F. V. Roy, L. Norvell, H. D. Smith, A. C. Dodge, F. H. Douglas, W. H. Stearns and C. T. Fugitt. Spaces 73-74-75-76-92-93-94-95.

Federal Signal Company, Albany, N. Y.—Electrical and mechanical signaling and interlocking apparatus. Represented by J. T. Cade, A. Dean and W. H. Reichard. Space 149.

Frank M. Foster, Columbus, O.—Foster interlocking switch stands with independent facing point lock and distant signal operated with one movement of one lever. Represented by Frank M. Foster and George E. Kalb. Space 138.

Franklin Manufacturing Company, Franklin, Pa.—Asbestos corrugated roofing and siding; asbestos "Century" shingles; asbestos building lumber and smoke jacks; 85 per cent. magnesia locomotive lagging; steam pipe and boiler coverings; special journal box packing; wool and cotton waste. Represented by R. J. Evans, L. B. Melville, E. R. Rayburn, A. L, Landry, Geo. Stewart and F. S. McNamara. Space 6.

General Electric Company, Schenectady, N. Y.—Railway signal and accessory and supply devices, mercury arc rectifier, gasoline engine generating set and railway signals in operation. Represented by Frank Rhea, H. K. Ferguson, F. B. Corey, L. A. Hawkins, W. W. Brown, A. G. Moore, H. L. Monroe, Chas. Ives, R. E. Russell, A. W. Jones, A. P. Jenks, L. G. Crawford and J. S. Button. Spaces 35-36.

General Railway Signal Company, Rochester, N. Y.—Electric interlocking machines, Model 2-A, electric motor signals for automatic block and interlocking systems, relays and other devices. Represented by W. W. Salmon, G. D. Morgan, M. Wuerpel, W. K. Howe, F. L. Dodgson, H. M. Sperry, J. L. Langdon, C. O. Poor, J. B. Evans, M. R. Briney, F. H. Jones, G. H. Macdonough and W. R. Young. Spaces 56-57-58-59.

Gifford-Wood Company, Chicago, Ill.—Ice handling machinery and ice tools. Represented by N. H. Williams and Geo. B. Vernier. Spaces 142-143.

Goheen Mfg. Company, Canton, O.—Preservative coatings for iron and steel and galvanized iron. Represented by Geo. L. Clapper and John G. Thompson. Space 182.

Goldie, William, Pittsburg, Pa.—Steel railroad tie, method of surfacing track and tie plugs. Represented by Wm. Goldie, Sr., Wm. Goldie, Jr., and E. E. Williams. Space 247.

Gray & Sons, Peter, Boston, Mass.—Signal lamps and lanterns, as follows: Switch lamps, semaphore lamps, engine classification and tail lamps, train tail lamps or markers, platform tail lamps, bridge lamps to government specifications, Gray's chimneyless long-time burners, switch and

semaphore lamps (oil), switch and semaphore lamps (electrically equipped). Represented by Geo. M. Gray and Jos. M. Brown. Space 109.

Greenlee Bros. & Co., Chicago, Ill.—Railroad tie machinery, automatic tie adzing and boring machines, screw spike driving machines, tie dowelling machines. Represented by J. A. Lounsbury, O. V. Haegg and F. Birtel. Spaces 7-8.

Grip Nut Company, Chicago, Ill.—Grip nuts. Represented by E. R. Hibbard, J. W. Hibbard, B. C. Wilt, W. G. Wilcoxson, Thos. P. Swan, J. W. Cuddy and A. E. Magurn. Space 55.

Hall Signal Company, New York, N. Y.—Automatic signal appliances. Represented by W. J. Gillingham, H. L. Hollister and W. H. Lane. Spaces 79-80.

Handlan-Buck Manufacturing Company, St. Louis, Mo.—Handlan Special lanterns, protected, direct top draft, signal lamps, long-time burners, locomotive train number indicators, McPartland rail clutches, track tools, metallic track and train flags, government standard bridge lights. Represented by A. H. Handlan, Jr., and R. L. Cairncross. Space 126.

Harry Bros. Company, New Orleans, La.—Corrugated metal culverts, corrugated iron tanks, knock-down portable galvanized iron houses. Represented by W. W. Chandler, W. H. D. Wheat, T. C. Harry, Jr., J. S. Cave and H. L. Harry. Space 193.

Hart Steel Company, Elyria, O.—Tie plates and spikes. Represented by W. S. Miller, W. T. Bentz, Willis McKee, G. S. Wood, A. W. DeRocher, H. W. Davis and J. M. Van Harlingen. Space 101.

Hayes Track Appliance Company, Geneva, N. Y.—Hayes derails and attachments. Represented by S. W. Hayes, W. Harding Davis, Wellington B. Lee and Arthur Gemunder. Space 140.

Heath & Milligan Mfg. Company, Chicago, Ill.—Mindura, an iron and steel preservative. Cement Coating, for waterproofing and decorating cement; stone, stucco and brick surfaces. Represented by A. M. Heath, J. H. Vance, F. J. Morse, Chas. F. Smale, Jr., Elmer F. Smith and W. S. Morgan. Spaces 275-276.

Hobart-Allfree Company, Chicago, Ill.—Smyth derailers, Freeland derailers, Newton car replacers and Newton divided car replacers. Represented by E. H. Allfree, W. H. England and J. Fremont Murphy. Space 17.

Hoskins Rail Joint Company, Chicago, Ill.—The continuous girder rail joint. Represented by Zach. T. Hoskins and N. L. Towle. Space 264.

Hubbard & Co., Pittsburg, Pa.—Railroad track tools, shovels and scoops, bolts, nuts and washers, pole line hardware. Represented by R. L. Mason, J. A. McLaughlin and B. S. Handwork. Spaces 197-198.

Hunt Company, C. W., West New Brighton, New York, N. Y.—Models of Skip hoist coaling station; automatic railway; conveyor; grab bucket, wheel and axle car with wheel and axle on it; turntable; curve, straight track and switch; charging car; shop car; Duplex valve and Simplex valve; coil of rope and couplings; photographs and drawings, section of conveyor. Represented by C. T. Anderson and A. C. Simmers. Spaces 222-223-224.

Ideal Concrete Machinery Company, South Bend, Ind.—Concrete block machines, concrete block power tamper, concrete brick machine, concrete stone products. Represented by H. I. Purcell, E. M. Blose, G. B. Pulfer and M. Wetzstein. Spaces 217-218.

Indianapolis Switch and Frog Company, Springfield, O.—Manganese frogs, crossings, switches, etc.; a special showing of I. Sw. & F. Company model R-N-R maganese frogs and crossings and tests. Represented by E. C. Price, W. H. Thomas, W. L. Walker, T. D. Hanley, G. S. Shaw, J. A. Foulks and J. C. Jameson. Spaces 12-13.

Ingalls-Shepard Forging Company, Chicago, Ill.—Standard mechanical interlocking parts. Represented by W. S. Foster. Space 3.

Interlocking Nut and Bolt Company, Pittsburg, Pa.—The Clark nut lock. Represented by R. A. Clark. Space 185.

Iowa Gate Company, Cedar Falls, Ia.—Farm, crossing and stockyard gates. Represented by Jos. B. Clay. Spaces 287-288.

Johns-Manville Company, H. W., New York, N. Y.—Asbestos and magnesia materials, electrical supplies, roofings, smoke jacks. Represented by J. W. Meek, J. C. Younglove, F. M. Gilmore, P. C. Jacobs, G. A. Nichol, C. E. Murphy, H. G. Newman, F. W. Doty, W. J. Hennessy, Geo. Christensen and G. W. Gearhart. Space 117.

Jordan Company, O. F., The, Chicago, Ill.—Steel constructed Jordan spreader and snow plows. Represented by M. J. Woodhull and M. Parks. Space 182.

Joyce-Cridland Company, Dayton, O.—Railway jacks. Represented by F. I. Joyce, George W. Llewellyn, Chas. D. Derby and N. Kohl. Space 11.

Kalamazoo Railway Supply Company, Kalamazoo, Mich.—Manufacturers of hand, push and velocipede cars, Improved track drills, jacks, pressed steel wheels, crossing gates and other track appliances. Represented by John McKinnon, Donald A. Stewart, W. I. Clock, Geo. W. Mingus, C. A. Wallace, W. N. Sidnam, Chas. B. Hays, H. P. Kauffer and Frank B. Lay. Spaces 23-24-25.

Kellogg Switchboard and Supply Company, Chicago, Ill.—Railway telephone equipment, including train dispatching sets, various types of portable telephones, siding telephones and ordinary telephones for use on both steam and electric roads. Intercommunicating sets, composite telephones, insulated telephones and private branch exchanges. Represented by J. C. Kelsey, G. A. Joy, Wm. Booth and Archibald Wray. Space 249.

Kennicott Company, Chicago, Ill.—Water softening plants, steel storage tanks, steel cars, steel underframes, general steel plate construction. Represented by Cass L. Kennicott, E. J. Flemming, Herman Nieter, Thomas Windes, Frank Dunham and Geo. Pratt. Space 16.

Kerite Insulated Wire and Cable Company, New York, N. Y.—Kerite insulated wires and cables. Represented by R. D. Brixey, Azel Ames, P. W. Miller, J. A. Renton, Watson Insulated Wire Company, Chicago, Ill.; J. V. Watson, B. L. Winchell, Jr., and E. B. Price. Spaces 60-61-62.

Kerlin Automatic Post Machine Company, Delphi, Ind.—Concrete fence post machine, reinforcements for concrete posts; lineal concrete railway tie. Represented by W. F. Kerlin, E. W. Bowen, E. R. Smock, Levi Riley, Stewart Benefiel, Wm. Donlin and Robert O'Connor. Spaces 210-211-212.

Kernchen Ventilator Company, Chicago, Ill.—Ventilators for passenger coaches, roundhouses and all buildings; chimney caps. Represented by G. E. Greer, W. A. Walkup and E. H. Miller. Space 278.

Keuffel & Esser Company, New York, N. Y.—Drawing materials, mathematical and surveying instruments, measuring tapes. Represented by Rudolph Link. Space 98.

King Fifth Wheel Company, Philadelphia, Pa.—Interlocking roller-bearing car pivot. Represented by Amos O. Chase. Space 285.

Lackawanna Steel Company, Buffalo, N. Y.—Rails, rail joints, structural and bridge material, reinforced concrete bars, steel sheet piling and track supplies special alloy steels, including Ferro Titanium, Bessemer rail steel. Represented by A. P. Van Schaick, C. H. Hobbs, G. A. Hagar, F. E. Abbott, Paul J. Kalman, H. H. Cook, J. L. Hench, John C. Chandler and A. H. Weston. Spaces 30-31-32-33-34.

Lansing Wheelbarrow Company, Lansing, Mich.—Warehouse trucks and track barrows. Represented by H. H. Ames. Space 254.

Lehon Company, Chicago, Ill.—Roofings, waterproofings, insulating products and paints; Roofrite roofing with overseal lap; car and cab roofing; waterproofed canvas for passenger cars, Lehon's car roofing, car sill covering, and Mule-Hide roofing, Per-Bona insulating paper, Dry-Art insulating paper, Lehon's Duplex refrigerator felt, Niagara waterproof paper, Roofine paint, Damptite waterproofing compounds, Staylastic paint. Represented by Tom Lehon and J. H. Brown. Space 171.

Lidgerwood Mfg. Company, New York, N. Y.—Hoisting engine. Represented by Frank B. Knight, W. G. Wilmot and E. C. Reeder. Space 206.

Link-Belt Company, Chicago, Ill.—Elevating and conveying specialties as applied to the handling of coal, freight, etc., by railways. Represented by J. C. Nellegar, W. W. Sayers and R. C. Turner. Space 128.

Lorain Steel Company, Johnstown, Pa.—Track Material—Solid manganese crossing; built-up crossing, 3-rail type; solid manganese frog; 4-rail manganese center frog; 6-rail manganese center frog; manganese wing rail frog; expansion joint; manganese split switch point; "Tadpole" tongue switch; guard rail clamp; heavy pattern cast steel combination joint; samples of electrically welded joints; sections of deep tee and M. C. B. guard rails; track skate. Represented by S. P. McGough, A. S. Littlefield, S. J. Cotsworth, Carroll Burton, F. J. Drake, A. L. Verner and H. C. Stiff. Spaces 204-205-208-209.

Luck Cement Post Mold Company, Aurora, Ill.—Galvanized molds in which concrete fence posts are made; also posts made in our system of molds. Represented by John G. Birtness, C. G. Birtness, M. J. Griffith, C. H. Klenze and F. S. Townsend. Space 274.

Lufkin Rule Company, Saginaw, Mich.—Measuring tapes of all descriptions, steel rules, etc. Represented by Theo. Huss, S. B. McGee and F. G. Brown. Space 121.

Lupton's Sons Company, David, Philadelphia, Pa.—Lupton steel sash, Lupton rolled steel skylight, Pond continuous sash, Pond operating device, details and large photographs

of shop construction. Represented by Clarke P. Pond and P. A. Sanborn. Space 54.

Luther Grinder Mfg. Company, Milwaukee, Wis.—Hand and foot power tool grinders, grinders of all description, with special attachments for sharpening chisels and twist drills. Represented by C. J. Luther. Space 255.

Lutz-Lockwood Manufacturing Company, Aldene, Union County, N. J., P. O. Roselle, N. J.—Gordon primary cells, "SX" ignition dry cells, "SX" magneto, Aldene dry cells. Represented by Geo. Marloff and W. M. Kinch. Space 133.

Manning, Maxwell & Moore, Inc., New York, N. Y.—Railway and machinists' tools and supplies, electric traveling cranes, Schmidt hack saw machine and other specialties will be shown. Represented by F. L. Peterson, R. S. Dean, R. R. Cuthbertson and C. H. Schmidt. Space 279.

C. F. Massey Company, Chicago, Ill.—Illuminated signals for highway crossings, Massey battery wells and battery chutes, reinforced concrete culvert pipe, relay boxes, posts and markers, rubber covered insulated wire, roofing material. Represented by Chas. F. Massey, R. J. Collins, Geo. R. Boyce, P. F. Lyons, B. J. Libbe and Chas. Pflasterer. Space 114.

Matthews & Brother, W. N., St. Louis, Mo.—Matthews' guy anchors, cable clamps, cable splicing joints, lamp guards, guy clamps and other money saving specialties. Represented by Claude L. Matthews, W. N. Matthews, Victor L. Crawford, Walter E. Bischoff and A. P. Eckert. Space 137.

Matthews & Rothermel, Chicago, Ill.—Steel sash for railway cars; Model of furnace door for locomotives. Represented by E. M. Matthews, W. E. Rothermel and Arthur Doer. Space 237.

McKinnis Switch Lock Company, Chicago, Ill.—Represented by C. E. Rosenfels. Spaces 259-260.

Merillat Culvert Core Company, Winfield, Ia.—Adjustable collapsible cores for making concrete culverts. The Merillat system of culvert construction. Forms in operation. Samples and pictures of work done. Repr sented by P. C. Merillat and C. C. Merillat. Spaces 256-257.

Alexander Milburn Company, Baltimore, Md.—Portable acetylene lights up to 10,000-candlepower for railroad construction, wrecking and inspection work. Represented by A. F. Jenkins and C. R. Pollard, Jr. Space 216.

Morden Frog and Crossing Works, Chicago, Ill.—Manganese frogs and crossings, Unity stand with facing point lock and distant signal, "G. L. M." automatic switch stand, compromise joints, facing point lock for Mansfield stands, guard rail, clamps, switch adjustments, rods and plates. Represented by Arthur C. Smith, H. M. Macke, W. J. Morden and D. H. Cusic. Spaces 107-108.

Mudge & Co., Burton W., Chicago, Ill.—Adams Motor Car. Represented by Burton W. Mudge, Herbert Green, Geo. E. Simmons, Otto P. Hennig, W. E. Adams, J. L. Phillips and Geo. W. Bender. Space 183.

Municipal Engineering and Contracting Company, Chicago, Ill.—Concrete mixing machinery, Chicago improved cube concrete mixer. Represented by C. E. Batrick. Space 37.

Nachod Signal Company, Philadelphia, Pa.—Electric railway track model operating actual signals, high speed trolley contractors, signal relay. Represented by Carl P. Nachod and F. W. Kulicke. Space 263.

National Corrugated Culvert Company, Warren, Pa.—American ingot iron corrugated culverts. Represented by G. H. Charls, G. F. Ahlbrandt, Ray Frazer, Joe DeFrees, A. B. Wilder and H. W. Forie. Spaces 99-100.

National Indicator Company, New York, N. Y.—Indicators for announcing the arrival and departure of trains. Represented by J. Hutchinson and E. M. Smith. Space 238.

National Lock Washer Company, Newark, N. J.—Exhibiting nut locks and special testing apparatus showing power exerted by spring washers under compression, and toughness of steel structure. Represented by F. B. Archibald, R. L. Brown, F. B. Buss and J. B. Seymour. Space 125.

National Malleable Castings Company, Columbus, O.—Malleable track specialties. Represented by F. R. Angell, H. I. Hiatt, J. J. Byers and L. W. DeWitt. Space 144.

National Roofing Company, Tonawanda, N. Y.—Security wide-weld roofing, surfaced with gravel and feldspar; other grades of cheaper roofing; asphalt roof coatings; asphalt paints; graphite paints; stack and metal protecting paints; pure lead, zinc and linseed oil paints; cement waterproofing, etc. Represented by P. E. Sinnett, T. M. Orr, A. E. Arbuckle and D. A. Bonitz. Space 277.

National Surface Guard Company, Chicago, Ill.—Surface cattle guards, track wrench, lock washers, steel grain doors. Represented by J. T. Hall, I. L. Bolinger and C. H. Luthman. Space 175.

Nichols & Bro., Geo. P., Chicago, Ill.—Electric turntable tractor. Represented by Geo. P. Nichols, S. F. Nichols and Henry Fries. Space 173.

Ohio Post Mold Company, Toledo, O.—One battery of six post machines designed for making 30 poured concrete fence posts at one time, one battery of four post machines for making 20 poured concrete fence posts at one time, several sample posts. Represented by A. M. Smith. Space 258.

Okonite Company, New York, N. Y.—Okonite wires; aerial, underground and submarine cables for all kinds and conditions of electrical service; potheads; cable joints; Okonite and Manson tapes; samples of crude rubber. Represented by L. G. Martin, F. J. White, J. M. Lorenz, H. M. Cox and C. E. Kacin. Space 18.

Patterson Company, W. W., Pittsburg, Pa.—Double extra heavy wood tackle blocks for manila rope, double extra heavy steel tackle blocks for wire cable. Represented by W. W. Patterson, Jr. Space 147.

Paterson Nut Lock Company, Philadelphia, Pa.—Paterson nut lock. Represented by D. S. Paterson. Space 293.

Pease Company, C. F., Chicago, Ill.—Automatic blue and white print machinery in operation. "Pease" Peerless Combination Equipment, for printing, washing and drying both the blue prints and the "Pease" Direct White Prints by one continuous operation. Motor driven trimming tables and other blue print apparatus. Represented by C. F. Pease, P. M. Morgan, Thos. Lord, T. K. Murney and C. A. Green. Spaces 161-162.

Pennsylvania Steel Company, Steelton, Pa., and **Maryland Steel Company,** Sparrows Point, Md.—No. 10 solid Manard frog, design 165; No. 10 Manard anvil face frog, design 160, made for Baltimore & Ohio Railroad Company; No. 15 ditto, made for Pennsylvania Railroad Company; No. 16 ditto, made for Lake Shore & Michigan Southern Railway Company; No. 10 Manard anvil face spring rail frog, right-hand, design 278, made for Pennsylvania Lines west of Pittsburg, right-hand Manard switch point, complete with housed stock rail, made for Pennsylvania Railroad Company; No. 8 Manard knuckle rail, design 710, complete with 2 open hearth movable points, made for Pennsylvania Railroad Company, New York terminal; straight double-groove tongue switch, Manard hard center construction, complete with lever box, made of 9-in. girder, Section 263, made for New York Central & Hudson River Railroad Company, and used in paved streets, Syracuse, N. Y.; low New Century adjustable switch stand, model 51-A; low Steelton positive switch stand, model 52-A; intermediate New Century switch stand, model 50-E, with semaphore attachment; intermediate main line safety switch stand, model 56-B; Acme rail brace, made of half-inch stock, to fit section 1001; sample Neverslip interlock switch plate, complete with detector brace and rail section; two sample Q. & C. Bozano compromise joints, model of steel coast line boat as built by Maryland Steel Company, marine department. Represented by G. S. Vickery, J. Drew Allen, Walter H. Allen, H. C. Banks, H. G. Barbee, E. Goodwillie, Stanley Smith, R. L. Weaver, R. E. Belknap, C. F. Rowland, John F. Hennessy, M. W. Long, W. M. Henderson, J. G. Miller, N. E. Salsich, C. Langdon and Thomas Earle.

Pittsburg Metal Products Company, Pittsburg, Pa.—Genuine American ingot iron, 99.94 per cent. pure plates, stack iron, sheets, locomotive jacket steel, boiler tubes, locomotive flues, pipe, merchant bars, angles, channels and rivets. Represented by T. G. Seixas, W. Lester Walker and A. P. Scott. Spaces 244-245.

Pneumatic Jack Company, Louisville, Ky.—Pneumatic lifting jacks and accessories. Represented by J. S. Leake. Space 240.

Pocket List of Railroad Officials, New York, N. Y.—Pocket list of railroad officials. Represented by J. Alexander Brown, Harold A. Brown and Chas. L. Dinsmore. Space B.

Potter-Winslow Company, Chicago, Ill.—Reinforced concrete battery chutes, storage battery containers, concrete foundations, posts, signs. Represented by Frank H. T. Potter, A. C. Heidelberg and George H. Davis, Jr. Space 174.

P. & M. Company, Chicago, Ill.—P. &. M. anti-rail creepers, arc lamp lightning arresters, bond wire protectors, photographs of P. & M. anti-creepers, in service. Represented by Philip W. Moore, Fred A. Preston, Alvar R. Sutter, L. W. Kent, Geo. E. Johnson and David T. Hallberg. Space 123.

Q. & C. Company, New York, N. Y.—Q. & C. Bozano joints, rolled steel step joints, cast-steel step joints; Bozano insulated joints, anti-rail creepers; rail benders; portable rail saws; guard rail clamps, rail braces, track re-laying machine; Kimball concrete tie. Represented by C. F. Quincy, G. C. Isbester, G. L. Hall, J. V. Westcott, H. E. McCormick, J. A. Bodkin, C. C. Rossire, A. R. Horn, J. J. Quinn and T. B. Bowman. Spaces 120-139.

Rail Joint Company, New York, N. Y.—Continuous, Weber and Wolhaupter types, base supporting rail joints. Represented by V. C. Armstrong, L. F. Braine, W. E. Clark, J. A. Grer, Percy Holbrook, H. C. Holloway, J. G. Miller, F. A. Poor, E. L. Van Dresar, B. Wolhaupter and F. C. Webb. Spaces 81-82.

Railroad Supply Company, Chicago, Ill.—Tie plates, derailers, signals. Represented by E. H. Bell, C. P. Cogswell, Jr., J. M. Comerford, E. W. Vogel and A. H. Smith. Space 85.

Railway Age Gazette (Maintenance of Way Daily) and The Signal Engineer, New York, N. Y.—Represented by Edward A. Simmons, Samuel O. Dunn, Lucius B. Sherman, John N. Reynolds, Henry Lee, Frank S. Dinsmore, Cecil R. Mills, Bradford Boardman, E. T. Howson, William Forsyth, W. E. Hooper, A. D. Cloud, H. H. Simmons, E. S. Faust, Kenneth G. Cloud, Harold D. Horton and T. E. Crossman. Spaces 44-63.

Railway List Company, Chicago, Ill.—The Monthly Official Railway List, Railway Master Mechanic, Railway Engineering and Maintenance of Way. Represented by Wm. E. Magraw, C. S. Myers, C. C. Zimmerman, J. M. Crowe, Warren Edwards, L. F. Wilson, N. F. Rehm and O. W. Midleton. Space 112.

Railway & Engineering Review, Chicago, Ill.—Represented by Willard A. Smith, Walter M. Camp, Clyde F. Burns, J. M. Lammedee, Robt. R. Greig, A. E. Hooven, G. E. Ryder, P. G. Stevens and Harold A. Smith. Space 20.

Ramapo Iron Works, Hillburn, N. Y.—Automatic safety switch stands; manganese pointed switches, manganese center frogs, solid manganese reinforced frogs, rolled manganese steel rail, guard rail, rail clamps; special switch slide plates, etc. Represented by Arthur Gemunder, W. B. Lee, W. C. Kidd, F. S. Stowell, James B. Strong, J. Edgar Davidson and W. W. Snow. Spaces 91-110.

Roberts & Schaefer Company, Chicago, Ill.—Working model of a Holmen fireproof structural steel locomotive coaling station, working model of a Sauerman Siamese coal breaker, enlargements of photographs of various types of locomotive coaling stations. Represented by Edward E. Barrett, Clyde P. Ross, Charles T. Malcolmson and James S. Shannon. Spaces 78-97.

Robertson Company, William, Chicago, Ill.—Plans and photographs of ash conveyors, sand dryers, pneumatic hoists, sand tower and sand valves. Represented by Thomas F. Lynch and William Robertson. Space 290.

Robinson & Co., Geo. M., Dubuque, Ia.—Metallic railway tie and fastenings. Represented by Geo. M. Robinson. Space 172.

Sandwich Electric Company, Sandwich, Ill.—Selective telephone and signal apparatus. Represented by E. C. Hennis. Space 248.

Scherzer Rolling Lift Bridge Company, Chicago, Ill.—Models, photographs, designs, plans, drawings and literature. Represented by Albert H. Scherzer, Fayette F. Soule, C. L. Keller, J. I. Vincent, J. T. Dickerson, W. F. Martin, H. D. Harting, R. W. Flowers and F. Roman Aszman. Space 178.

Sellers Manufacturing Company, Chicago, Ill.—Tie plates, angle bars, "Sellers Anchor Bottom Tie Plate." Represented by J. M. Sellers, J. T. Markham, L. S. Gordon and T. J. Hopkins. Space 124.

T. W. Snow, Chicago, Ill.—Railway water appliances. Space 179.

Spencer, Otis Company, Chicago, Ill.—Tie plates called "Economy Tie Plates;" also exhibiting the American Kron scale. Represented by W. L. DeRemer, Carter Blatchford, L. D. Rockwell, Geo. Ringhausen, W. D. Thompson, C. G. Rank, Chas. A. Coons, H. T. Hart, A. S. Flowers, H. G. Fennel, O. M. Olson, Avery Robinson and G. H. Goodell. Spaces 122-141.

Standard Asphalt & Rubber Company, Chicago, Ill.—Sarco products and methods as applied to waterproofing railway structures. Represented by W. H. Lawrence.

Standard Paint Company, New York, N. Y.—Ruberoid roofing, Ruberoid car roofing, insulating papers, railway equipment and bridge paints. Represented by John H. Thomas, B. C. Beckman and H. A. Inwood. Space 159.

Standard Scale & Supply Company, Chicago, Ill.—"The Standard" scales, freight and warehouse trucks, Eclipse low charging concrete mixer. Represented by M. H. Reed, Jos. Simpson, W. A. Browning, F. F. Gillett and A. N. Hundley. Space 49.

Standard Underground Cable Company, New York, N. Y.—Bare and insulated copper wires, bare and insulated copper-clad wires. Represented by H. P. Kimball, R. G. Harris, E. J. Pietzcker, Russell E. Green and B. S. Stewart. Space 286.

Steam Shovel & Dredge Journal, Chicago, Ill.—A journal devoted to railroad construction work, railroad contractors' supplies and equipment of every description. Represented by T. J. Dolan, Matt. Brady and James F. Conigan.

Sterling Varnish Company, Pittsburg, Pa.—Sterling iron enamel paints, Sterling Row refined linseed oil. Represented by W. V. Whitfield and W. F. Heberd. Space 150.

Strait Scale Company, Kansas City Mo.—Strait Standard heavy special railroad pattern track scales, also other patterns and other scales used by railroads. Strait improved type registering beams. Represented by Wm. M. Welsh. Space 194.

Strauss Bascule Bridge Company, Chicago, Ill.—Photographs, plans and modles of Strauss bascule bridges. Represented by J. B. Strauss and C. S. Davis. Space 160.

Taylor Lock Nut Company, Salt Lake City, Utah.—Lock nuts, showing their application to track and car work. Represented by R. E. Gray and E. W. Taylor. Space 252.

..Templeton, Kenly & Company, Ltd., Chicago, Ill.—Simplex track and car jacks. Represented by A. E. Barron, J. H. Hummel, W. B. Templeton and W. Harding Davis. Spaces 4-5.

Union Iron Works, Hoboken, N. J.—Steam and air pile driving hammers and equipment. Contractors' equipment. Represented by Max Schalscha. Space 215.

Union Switch & Signal Company, Swissvale, Pa.—Interlocking and signaling apparatus for steam and electric railways, including electro-pneumatic, electric and electro-mechanical interlockings in operation; signals, relays and other apparatus for A. C. or D. C. automatic block signaling; staff system for use on steam and electric railways of the "Operator" and "No-Operator" type; electric crossing gates and bells, Keystone insulated rail joints, mechanical interlocking derails, etc. Represented by Col. H. G. Prout, J. G. Schreuder, S. G. Johnson, J. S. Hobson, G. A. Blackmore, H. W. Griffin, T. H. Patenall, W. M. Vanderslius, J. L. Brastow, W. H. Fenley, J. P. Coleman, L. F. Howard, M. D. Hanlon, W. H. Cadwallader and J. D. Taylor. Spaces 40-41-42-43.

United States Electric Company, New York, N. Y.—The Gill selector, railway signals and electrical devices. Designers of railway telephones. Consulting Electrical Engineers. Represented by W. L. Cook., Edw. E. Backus and M. E. Launbranch. Space 250.

U. S. Metal & Manufacturing Company, New York, N. Y.—"Diamond" tapered steel poles; Wolfe automatic rail joint lock; Columbia lock nuts, St. Louis surfacer paints and target enamels. Represented by A. A. Hegeman, Jr., Chas. C. Castle, F. C. Dunham and Arthur Masters. Space 19.

U. S. Wind Engine & Pump Company, Batavia, Ill.—Water columns, tanks, tank fixtures, steel sub-structures (all in model), switch stands. Represented by L. E. Wolcott, A. J. Anderson and C. E. Ward. Space 111.

Universal Metallic Tie Company, Salt Lake City, Utah.—A steel cross-tie. Represented by J. W. Johnson and B. S. Rupp. Space 207.

Verona Tool Works, Pittsburg, Pa.—Track tools, track jacks, track gauges, nut locks. Represented by W. D. Hechler. Space 148.

Waterloo Cement Machinery Corporation, Waterloo, Iowa.—Polygon concrete mixer mounted on trucks with gasoline engine and automatic loader. Polygon contractors' and builders' gasoline hoist. Represented by C. D. Walworth, F. H. Clarke and H. F. Worden. Space 192.

Weir Frog Company, Cincinnati, O.—Railway frog, switch stands, guard rail clamp, maganese frog. Represented by N. O. Goldsmith and F. W. Allen. Space 226, Balcony.

Weir & Craig Manufacturing Company, Chicago, Ill.—Electric turntable tractors, compressed air turntable tractors, pneumatic and hydraulic drop pit tables, transfer tables, electric portable hoists, compressed air portable hoists, locomotive drop pit jacks (pneumatic and hydraulic). Represented by Fred G. Whipple and R. W. Young. Space 145.

Weisell Nut Lock Company, Chicago, Ill.—A nut-lock in the form of a lock nut. Represented by C. J. Grady, M. G. Cheney and E. H. Stolz. Space 167.

Western Electric Company, New York, N. Y.—Railway telephones for train dispatching, siding telephones, portable telephones for train crews and all telephone apparatus, fan motors, arc lamps, installation material; Buffalo grips, Mazda lamps, bells and buzzers. Represented by H. L. Porter, D. C. Guest, M. A. Oberlander, G. K. Heyer, W. H. Doherty and H. L. Grant. Space 181.

C. H. Whall & Company, Boston, Mass.—"Whall's Special Railroad Fibre" for insulating rail joints, etc. Fusees for train protection. Represented by F. R. Whall and John B. Given. Space 127.

Wm. Wharton, Jr., & Company, Inc., Philadelphia, Pa.—Manganese steel switches, frogs, crossings and movable points; switch stands, guard rail clamps, anti-creepers, models, photographs, etc. Represented by V. Angerer, L. R. Ashhurst, Jr.; R. C. McCloy, W. B. Cooke, W. McLain and Arthur S. Partridge. Spaces 9-10-28-29.

Whitehead, Jos., Farmington, Ill.—Composite tie, metal and concrete railway tie. Represented by Jos. Whitehead. Space 291.

Winan's Improved Patent Rail Joint Company, Portland, Ore.—A base supported rail-joint. Represented by Audobon Winans. Space 185½.

At the Coliseum

R. E. Derby, formerly in the sales department of Fairbanks, Morse & Co., Chicago, recently has become associated with Joseph M. Brown, 303 Great Northern building, who is local representative for Peter Gray & Sons, Boston, Mass., manufacturers of railway and signal lamps and lanterns.

The Concrete Form & Engine Company, Detroit, Mich., exhibits the Belle Isle, 2 to 2½ h. p. gasoline engine, designed for track velocipedes used by signalmen. It weighs only 73 lbs. and costs less than $50. The company has at the Coliseum a giant telegram, giving an account of an emergency run made by R. F. Smith, Myerstown, Pa., with one of the Belle Isle engines.

The Vanadium Sales Company of America, Pittsburgh, Pa., recently secured a remarkable test of Vanadium steel taken from cast steel pinions after their final treatment. The tensile strength was 112,010 lbs., the elastic limit 63,180 lbs., the elongation was 20 per cent. in 2 in., and the reduction in area 49.6 per cent. This company predicts that railways will be using Vanadium steel castings for wheel centers, as well as locomotive frames, in the near future.

R. N. Baker, who has been identified with the signal supply business for a number of years, resigned his position with the Bryant Zinc Company, Chicago, last week, to go to the Western Electric Company, Chicago, in one of the departments which are not connected with railroading. Mr. Baker was formerly with the Batteries Supplies Company, now owned by the Edison interests, and was in the sales department of the Western Electric Company previous to his entrance into the signal field.

RESTORED WHARTON MANGANESE STEEL FROG.

The restored frog in the exhibit of Wm. Wharton, Jr., & Co., Inc., Philadelphia, Pa., is one of a number of manganese steel frogs that the Wharton company has brought back to life, so to speak. The process is a patented one belonging to the company, and consists of releveling the surface of the manganese part by bending and grinding and fitting the frog with new rails. The important feature about the frog on exhibition is that this is the second time it has been restored. The original frog was in service a number of years before it was rejuvenated, and almost the same length of time after the process was applied. After the convention the frog is to go back into the track for the third time.

VALVES AND POWER PLANT FITTINGS.

The Crane Company, Chicago, is exhibiting an extensive line of valves, fittings and specialties, for use in power plants, wood preserving plants, and for railway service in general, in space 146 at the Coliseum.

One of the most interesting features of this exhibit is a straight-way valve for creosote with a clean-out pocket. The company is equipped to furnish these valves in both the wedge gate and double disc parallel seat types and for all working pressures. These valves are made from materials that will best withstand the deteriorating effects of creosote or zinc chloride. A working exhibit of steam traps is another unique feature. These steam traps, connected up with other apparatus, illustrate clearly, by actual operation, the inexpensive up-to-date method of removing condensation from steam lines or separators of a power plant and returning it to the boilers. The pipe bends, which span the Crane Company booth, are products of its plant. No expense has been spared in the equipment of this department of the factory. To meet the requirements of modern power plants, the Crane Company recommends motor-operated gate valves. These valves are among the foremost of steam specialties. One of them is on exhibition, connected up as it would be in a power plant.

In addition to the other articles, a complete line of valves for locomotive service is shown. These are especially designed for use in connection with injector, hose sprinkler, air pump, blower, lubricator, steam heat and throttles. These valves are of durable construction, have long threads, and all wearing parts are made to withstand the severest and most trying service.

TIE PLATES.

A few years ago manufacturers of tie plates offered the trade only a few designs to choose from and engineers were compelled to order the one that seemed to be best suited for their needs. The requirements of the different lines, on account of the variation in traffic conditions and also on account of the different kinds of ties used, have necessitated the designing of many new plates to meet the particular requirements of the several roads. The Hart Steel Company, Elyria, Ohio, has recognized this situation and has equipped itself to manufacture a large line of plates. Starting with a flat top flanged plate and a corrugated top flanged plate, it has introduced a four-flanged shoulder plate and a central flanged shoulder plate, besides numerous designs of tie plates which are rolled with or without any flanges on the bottom or with short flanges parallel to the shoulder. It also rolls the heavy double shoulder plate used by the Pittsburgh & Lake Erie. Besides these designs, the company offers a large number of screw spike tie plates, some of which have novel features. Numerous samples are on exhibition at Booth 101 in the Coliseum.

POSITIVE RAIL ANCHOR.

Most rail anchors depend on the gripping of the edge of the rail flange for stopping rail movement, but the Positive rail anchor, which is here illustrated, takes advantage of the natural wedge shape of the base of the rail and obtains the desired result by the use of a wedging jaw. This is a one-piece rail anchor with no bolts, keys, rivets, wedges or set screws. No wrenches or special tools are required for its application, and a light hammer is all that is necessary for

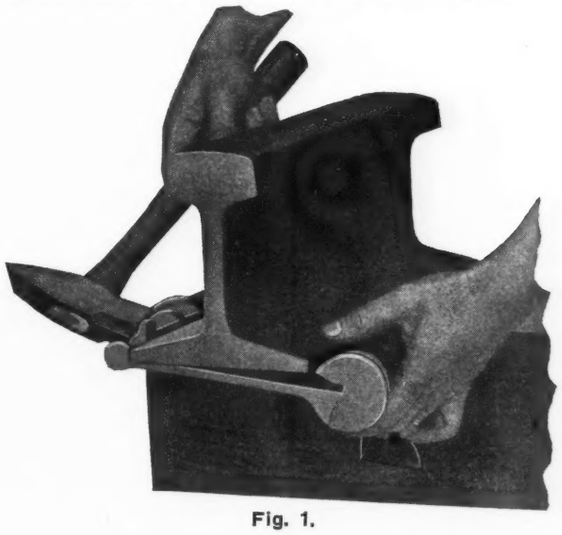


Fig. 1.

this purpose. The manner of application is illustrated in the cuts. In Fig. 1 the small jaw is placed over the edge of rail base and is driven on with hammer until the back wall of the small jaw is in contact with the edge of base. The anchor is then lifted into place, engaged with the wedging jaw, and is then moved forward until its foot is in contact with the tie. The small jaw is then driven forward with a few light blows and this will wedge the large jaw firmly on rail base. The operation is finished by driving the bendable lug on the cap

of small jaw, down on side of rail base, as shown in Fig. 2. This will completely lock the anchor on rail.

To remove the anchor drive a chisel, or wedge the end of a track spike under the back end of bendable lug until it is sprung back to its natural position, then drive the small jaw

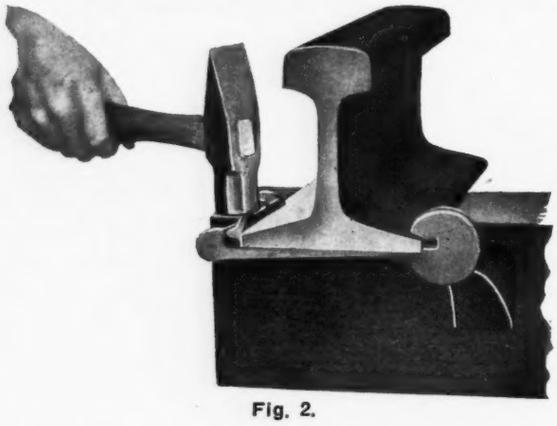


Fig. 2.

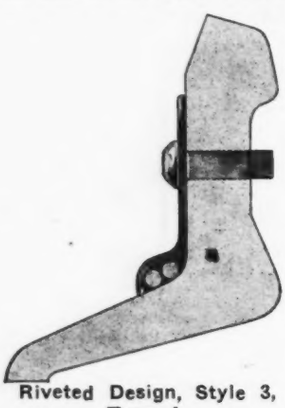
back from tie. The wedging hook can then be removed and the anchor becomes loose. The Positive Rail Anchor Company is incorporated, and the president's office is at 2910 High street, Louisville, Ky. The secretary and treasurer's office is at Marion, Ind.

STEEL WINDOWS.

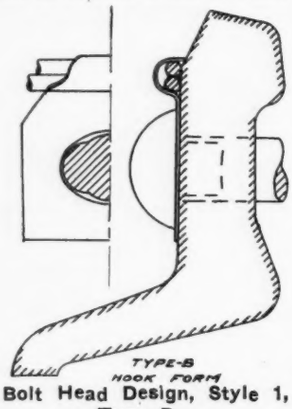
Many architects and engineers are familiar with the merits of Detroit Fenestra solid steel windows for industrial construction, manufactured by the Detroit Steel Products Company, Detroit, Mich., and will be interested to know that this company has just become exclusive distributor in the United States for the metal casement windows manufactured by the Crittall Manufacturing Company, Ltd., London, England. These metal casement windows are used in office buildings, banks, public buildings and residences. The company is now prepared to furnish designs and estimates for steel casement windows for this class of construction.

BOND WIRE PROTECTORS.

During the past year the use of the bond wire protector has been widely extended. The function of this devise is to hold bond wires in such a position with regard to the bolts and nuts in the splice, that they will be free from interference



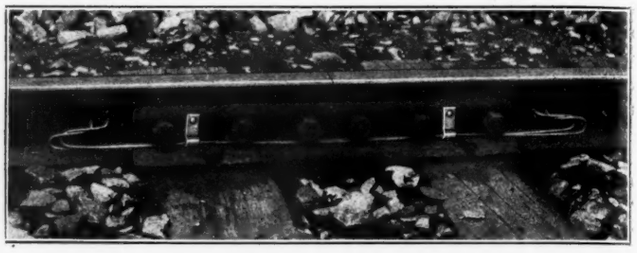
Riveted Design, Style 3, Type A.



Bolt Head Design, Style 1, Type B.

and breakage by track men and incapable of disturbance by malicious persons. During the rapid increase in track mileage under automatic signals, proper maintainance of bond wires has been overlooked in some cases, as shown in the cut herewith.

Only a small percentage of bond wire breakages is ever reported to the signal engineer. In the majority of cases when one bond wire is found broken, the other being in good shape, no signal failure results and the maintainer simply re-bonds the particular broken wire. Bond wire breakage is, however, a very common source of trouble to the maintainer, and quite a source of expense to the railway company. Aside from the large number of breakages which do not cause



Protected Bond Wires.

signal failures, there are a certain number of cases of breakage which do cause signal trouble. The bond wire protector largely does away with such breakage, can be applied at low first cost and requires practically no attention after application. The bond wire protector is offered in two general types. One design is held in place by the bolt head, the second design is riveted into the angle bar with the usual 9-32 in. bonding rivet, the clip being furnished complete with the rivet. Both designs are furnished at the option of the purchaser to hold the wires either above or below the bolts.

Unprotected Bond Wires.

When properly applied, the track bonding presents a very neat appearance.

The bond wire protector is standard on several of the largest railway systems in the country, and its use is extending rapidly. The P. & M. Co., Chicago, which was formerly known as the Railway Specialty & Supply Co., has been marketing this device for the last several years, each year seeing a large increase in sales over the preceding year. A very complete exhibit of bond wire protectors as applied to the rail may be seen at booth No. 123 of the P. & M. Co., at the Coliseum this week.

SCHERZER ROLLING LIFT BRIDGES.

The pronounced tendency in railway development during the last few years both in the United States and abroad has been the concentration of traffic on existing rights-of-way by means of double and multiple track construction rather than the building of adjacent competing lines. On many of our prominent railways traffic has increased so rapidly during the past few years as to require two, four, six and even eight parallel tracks for its accommodation and economic building.

An inherent limitation of the center pier swing bridge for railway traffic is the fact that it cannot be enlarged or widened to accommodate additional tracks, necessitating its being discarded and removed, frequently when only a few years old. This difficulty is overcome by the bascule

bridge, designed by the Scherzer Rolling Lift Bridge Company, Chicago, which can be constructed as a single-track structure and enlarged to a double or multiple track bridge at any time, without disturbing traffic or interfering with the existing bridge, by simply adding any number of new bridges alongside of the existing structure as they are needed. They can be operated as separate units or can be linked together and operated as one structure.

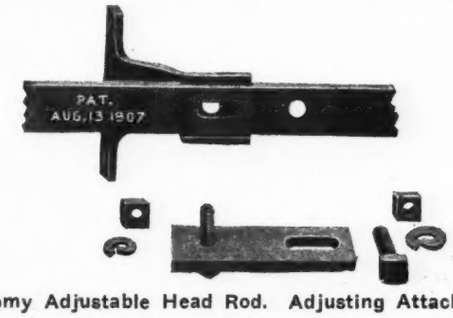
Some of the more notable Scherzer rolling lift bridges are the four-track bridge for the Metropolitan West Side Elevated, Chicago, which has safely carried more than 1,500 trains daily during the past fifteen years; the double-track bridge of the Baltimore & Ohio Chicago Terminal Transfer at the entrance to the Grand Central station—the longest span and most frequently operated bascule bridge in the world, in service for more than ten years; the eight-track bridge at Chicago used by the Pennsylvania Lines, the Baltimore & Ohio Chicago Terminal Transfer and the Chicago Junction, the widest movable bridge ever constructed; the single-track bridge for the Big Four at Cleveland, Ohio; the double-track bridge used jointly by the Big Four, the Lake Shore & Michigan Southern and the Erie at Cleveland; the two adjacent double-track bridges used by the Newburgh & South Shore and Baltimore & Ohio at Cleveland; the 230-ft. span single-track bridge for the Baltimore & Ohio at Cleveland; the double-track 160-ft. bridge at Cleveland, for the New York, Chicago & St. Louis; the two double-track bridges used by the Central of New Jersey, the Reading and the Baltimore & Ohio across Newark bay, New Jersey; the double-track bridge for the Boston, Revere Beach & Lynn, and the six-track bridge at the entrance to the South terminal station at Boston, for the New York, New Haven & Hartford, in service for more than twelve years. This company in the process of multiple tracking its lines has built four-track Scherzer rolling lift bridges at Neponset, Mass., Bridgeport, Cos Cob and Westport, across the Housatonic river, Connecticut, and a long span double-track bridge across the Connecticut river; also a double-track bridge across the Seekonk river at Providence, R. I. Six-track bridges, consisting of three independent double-track bridges side by side, have also been constructed by this company across the Bronx river and across Eastchester bay on the Harlem river branch of their New York division. The New York Central Lines have constructed a double-track Scherzer rolling lift bridge across Wappinger creek on the main lines of the Eastern division, to be four-tracked in the future; double-track bridges for the Lake Shore & Michigan Southern and Chicago, Lake Shore & Eastern have been constructed at Indiana Harbor across the new East Chicago canal. The Norfolk & Western in the process of double-tracking its lines has constructed two Scherzer rolling lift bridges, one across the Southern and the other across the Eastern branch of the Elizabeth river at Norfolk. The Seaboard Air Line has constructed a long span single-track Scherzer rolling lift bridge across Hillsboro bay at Tampa as a part of the new terminal improvements being made at that point. It has also this month completed a Scherzer rolling lift bridge across the Savannah river at Savannah, Ga. A single-track Scherzer rolling lift bridge has been constructed by the Norfolk & Southern, forming a movable span in its very long trestle across Albemarie sound between Edmonton and McKay's Ferry. A single-track Scherzer rolling lift bridge has been completed across Rainy river for the Duluth, Rainy Lake & Winnipeg and Canadian Northern. The San Pedro, Los Angeles & Salt Lake has also completed a long span Scherzer rolling lift bridge across the San Gabriel river at Long Beach, Cal. Other prominent Scherzer rolling lift bridges have also been recently completed or placed under construction for the following railways: The Georgia & Florida at Hazlehurst, Ga.; the Long Island at Long Island City; the Buffalo, Rochester & Pittsburgh at Rochester; the Brooklyn Rapid Transit at Coney Island; the Southern Pacific, Gould Lines and the Santa Fe as a part of the Galveston Causeway, Texas; the Baltimore & Ohio, Cleveland; the M. St. P. & S. S. M. at Portage, Wis.; the E. J. & E. at Whiting, Ind.; the Southern at Augusta, Ga.; the Central of New Jersey at Elizabeth.

The Scherzer rolling lift bridges constructed or placed under construction for foreign railroad service are very numerous, the more prominent being the double-track bridge for the South Eastern & Chatham across the Swale river, England; the double-track bridge for the Fishguard & Rosslare Railways & Harbors Company across Suir river, Ireland, on their high-speed connection with the Great Western Railway of England; three bridges for the Dutch Railroad Company, Holland; two double-track and one single-track bridge for the Buenos Ayres Great Southern at Buenos Ayres, Argentina, a 220-ft. span bridge for the Burma Railways near Rangoon, India; two bridges for the Tehuantepec Railway at Salina Cruz, Mexico; the long span double-leaf bridge for the South Indian Railway, connecting their system with the railway systems of the Island of Ceylon; the Canadian Pacific at Fort William, Ontario; the Furness, England, and the Cape to Cairo Railroad at Port Soudan.

More than eighty single and double track Scherzer rolling lift bridges have also been constructed and placed under construction to accommodate local and interurban electric railway traffic, nearly all of these bridges accommodating double electric railway tracks.

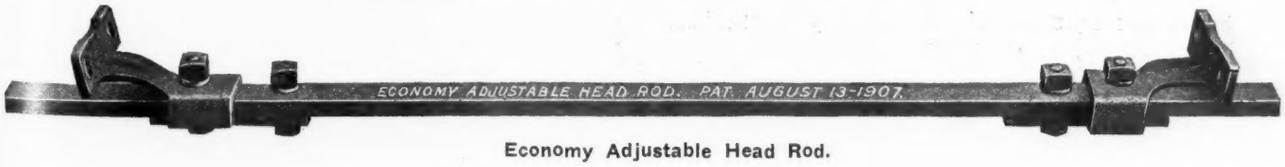
ECONOMY ADJUSTABLE HEAD ROD.

The Economy Separable Switch Point Company, Louisville, Ky., makes an adjustable head rod, shown in the accompanying cuts. It is made of a solid bar of iron or steel, ready for installation in the track. The bars when installed are strong



Economy Adjustable Head Rod. Adjusting Attachments.

and rigid and require no attention after installation. The adjusting attachments allow for an adjustment of 1½ in. at each end, and are applied at the points of greatest stress in the head rod, forming reinforcements, as well as adjustments. The makers claim for this rod a high efficiency, ease of adjustment, rigidity and strength.



Economy Adjustable Head Rod.

ELECTRO-MECHANICAL INTERLOCKING MACHINE, STYLE P.

The electro-mechanical machine applies many of the advantages of power interlocking to a mechanical plant, requires less energy for its operation, provides a reliable means for switch and signal indications, permits the use of electric detector locking eliminates facing point locks, bolt locks and detector bars, and, in addition, reduces the size of the tower required.

The large machine is of the Saxby & Farmer type and is furnished in standard sections, the levers being spaced 5 in. center to center. The miniature levers, spaced 2½ in. centers, are mounted above the large levers and so arranged that the small controlling switch levers are directly over the large levers controlled by them. The miniature signal control levers are placed between the switch levers and are for control of power-operated signals. The mechanical locking between levers is actuated entirely by the miniature levers, thus reducing to a minimum the liability of forcing or straining the locking.

The actual operation of a switch is accomplished by the large lever, and the mechanical locking is actuated and the indication taken from the miniature one. The electric levers are fitted with the electric lock and spring combination features identical with those used on the electro-pneumatic interlocking machine.

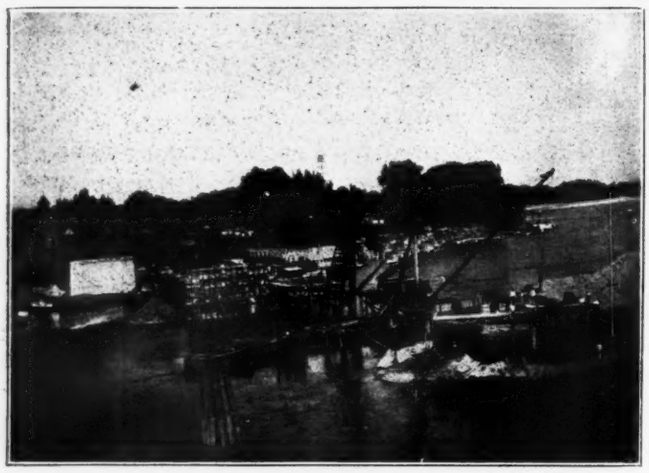
The miniature levers are made in multiples of two, and the operation of a switch lever is as follows:

1st. Throw the miniature lever to the middle position, actuating the locking and releasing the large lever for the operation of the switch. 2d. Operate the large lever. 3d. Complete the stroke of the miniature lever after the indication is received, which locks the large lever and also completes the stroke of the mechanical locking, releasing the signal levers.

This machine is made by the Union Switch & Signal Company, Swissvale, Pa.

SACRAMENTO BRIDGE; SOUTHERN PACIFIC.

The Missouri Valley Bridge & Iron Co., Leavenworth, Kan., recently completed the substructure for a bridge over the Sacramento river at Sacramento, Cal., for the Southern Pacific. The piers for this structure were sunk



Sinking Pivot Pier, Sacramento River Bridge of the Southern Pacific.

in hard gravel by the pneumatic process, the caisson pivot pier being 54 ft. in diameter. The accompanying view shows the general layout of the work during the construction of this pier, the piles of sand near the pier having been placed there by the government while deepening the channel. A very economical arrangement of concrete plant was used on this work, materials being received in cars on an elevated track back of the bins, which were located above and just back of the mixer. Concrete was delivered from the mixer to the piers by a small locomotive. No wheeling or shoveling was required in the entire operation of placing the concrete.

UNIVERSAL METALLIC TIE.

The Universal Metallic Tie Company, Salt Lake City, Utah, has on exhibition at Booth No. 207, at the Coliseum, several of its Universal Metallic ties. This tie is now in service on several roads and installations are being made on others.

The design is the trough type, being a 6-in. x 8-in. x 8-ft. steel channel. Holes are cut in the web of the channel on

Universal Metallic Tie in Pennsylvania Lines Tracks.

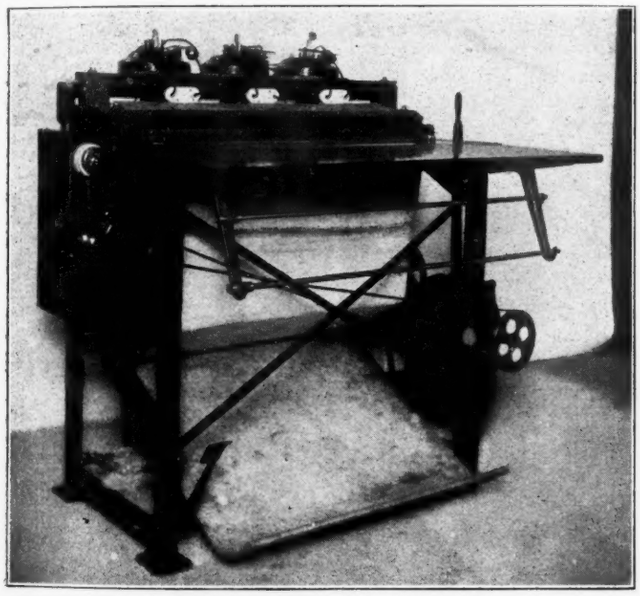
each side of the rail, and this metal is bent up vertically on each side of a wooden block which fits in the channel under the rail. Clamps, fitting over the base of the rail and extending down vertically outside these bent-up portions of the channel, bind the block, rail and tie together. The clamp on the gage side of the rail extends through the hole in the base of the channel about 4 in. into the ballast, giving an additional bond with the roadbed. A bolt with a tapering head at one end and with a tapering washer at the other end holds the connection tight. An insulating fiber is inserted between the rail and the clamp. The weight of this tie is 175 lbs.

The makers claim that with such a tie track work is much simplified, and that spikes, tie plates, rail anchors and braces are eliminated, materially reducing the number of parts to be watched by the section forces. The accompanying photograph shows these ties in service in the main line of the Pennsylvania Lines West, near Emsworth, Pa., where they have been in service since last November. The New York Central is also using them in main line at Fort Washington, N. Y., while they are in the main track of the Pittsburgh & Lake Erie, near Pittsburgh. They are installed in the main line of the Santa Fe, near Twenty-first

street, Chicago, and at Newton, Kan., while they have just been put in the main freight line of the Chicago, Burlington & Quincy, near Western avenue, Chicago.

PEASE BLUE PRINT PLANT.

The C. F. Pease Company, Chicago, is now placing on the market the complete equipment shown in the illustration and known as the Pease Peerless continuous electric blue-printer. The methods first employed in reproducing plans were very crude, consisting of a sun frame projected from the window, subject to the caprices of the weather, and resulting frequently in damaged tracings by a sudden shower. Then came the vertical electric printer, which was a long step in advance but still subject to great limitations and involving a large amount of labor in loading and unloading, necessitating the printing of log tracings in sections. Following this came the continuous electric printer, permitting the printing of tracings of any length in one piece, but still the methods of washing in trays and drying by looping over sticks prevailed, resulting in uneven drying and distortion of the prints. By the process described below, printing, washing and drying can be done



Pease Automatic Blue Print Machine.

automatically, greatly reducing the labor as well as the wear and tear on tracings and producing better prints.

The tracings are placed on the sensitized paper face upward and are carried by an endless canvas belt past the bank of specially designed arc lamps, enabling the operator to see the work as it progresses and immediately give it the proper exposure for best results. All tracings are returned direct to the operator, thereby giving the least possible wear on the tracings and enabling him to handle long tracings from the roll to the roll without kinking, while small tracings can be handled with equal facility. Sixty changes of speed can be made directly through the motor, and it is possible for the operator to make these changes instantly to suit the work without leaving the front of the machine. The endless canvas belt is held in place by tension springs, so that the contact is perfect at all times, and there is no shifting of the belt. At the same time it is possible, by means of the foot treadle, to release a tracing at any moment, thus allowing the printing of a portion of a large tracing. The sensitized paper, immediately after leaving the printer, passes through the Pease automatic washing and drying machine, by which the prints are thoroughly washed and dried as fast as they are printed, winding up automatically at the end of the machine, ready to be cut off at any time. The result of this continuous method of washing and drying is that the prints are free from stick marks and wrinkles and are dried evenly without distortion.

This company also makes a combination machine with which it is possible to make both ordinary blue prints and Pease direct white prints from a tracing without negatives. These white prints are fast color and will not shrink. They are largely used for material bills, statistical matter and maps. It is possible to change this combination machince from direct white prints to blue prints, or vice versa, without stopping its operation. The combination features in this machine effects a considerable saving in space, doing away with large washing trays and also in labor, as the entire work of washing and drying the prints is eliminated.

The Pease Company, in designing the above equipment, has paid a great deal of attention to mechanical details with the idea of producing the largest volume of prints at the smallest operating expense and maintenance cost. This apparatus can be seen during the week of the convention at the Coliseum, sections 161 and 162.

EIGHT-TRACK ROLLING LIFT BRIDGE.

The accompanying cut shows the eight-track Scherzer rolling lift bridge over the Drainage Canal at Thirty-first street and Campbell avenue, Chicago. This bridge, which is the largest structure of its kind in the world, has four

Eight-Track Scherzer Rolling Lift Bridge Over Drainage Canal, Chicago.

154-foot spans, each of the single-leaf type and each designed for an E-55 loading. This structure replaced four incomplete Scherzer bridges of the two-leaf type which had been built in 1901 without segmental girders or operating machinery. The bridges were to have been completed later, and in the meantime were used as three hinged arches. When it became necessary to provide movable spans it was found that the new bridge as actually built would cost but little more than to complete the structure then in place. It was accordingly decided to replace entirely the old structure, which was done without interruption of traffic, only one leaf being out of operation at one time.

Some idea of the weight of the bridge may be gained by considering the fact that each of the eight segmental girders, with a radius of 28 ft., weighs 55 tons, and each of the eight track girders weighs 65 tons. Of the eight tracks, the Pennsylvania Railroad has four, the Chicago Junction two, and the Chicago Terminal Transfer two. The general contract for this structure was let to the Chicago Bridge & Iron Works, Chicago, who completed the work about July 1, 1910.

SEMAPHORE OIL.

Semaphore long-time burning oil, which is manufactured and sold only by the Maloney Oil & Manufacturing Company, Scranton, Pa., is refined to meet the exacting demands of signal work. It is produced from a high-grade Pennsylvania crude oil which contains no sulphur. Tests show that it will burn for over 150 hours without causing the lampwick to be crusted over and retains a high candle power until burned out. In one test the lamp was kept burning for four months and the incrustation was so slight that the flame was not materially affected.

This oil is produced at the company's refinery at Oil City, Pa., and is placed in new barrels especially prepared for that purpose. It will remain clear at zero temperature and does not show a cloud at 10 deg. below zero, which qualifies it for winter service as well as summer. The fact that it lasts longer and gives a better light more than compensates for the price being a little higher than for ordinary oil. In fact, the saving in labor of attendance alone will overcome the difference in price. The Semaphore brand is copyrighted.

RECENT INSTALLATIONS OF STRAUSS BASCULE BRIDGES.

The Strauss Bascule Bridge Company, Chicago, has made exceptional progress in the installation of large movable bridges during the past year. This company now devotes itself exclusively to movable bridges and in particular to the Strauss bascule bridge. This design has been perfected to a high degree and the company has been rewarded for its efforts by a large number of contracts from the railways in the United States and Canada.

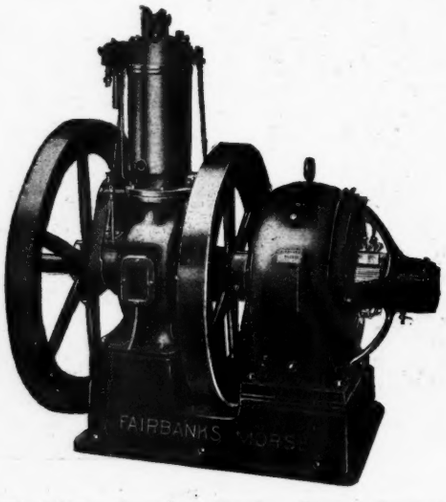
Strauss Bascule Bridge at Buzzard's Bay.

Among the large bridges now under way are the following: A single leaf, double track, double deck bascule bridge, 186 feet long, for the Canadian Pacific at Ft. William, Ont., which is the first of its kind; a single leaf, four-track bascule bridge for the Lake Shore & Michigan Southern at Port Clinton, Ohio, also the first of its particular design; a double leaf cantilever bascule bridge for the city of Portland, Ore., which is 278 feet center to center of piers and 71 feet wide, one of the largest bridges in the world; the bascule span of the Palace bridge at St. Petersburg, Russia, one of the most ornate designs in the world. The Peoria & Pekin Union, the Transcontinental of Canada, the Northern Pacific, the Chicago & Western Indiana and the Lake Shore & Michigan Southern, each have large single leaf, heel trunnion bascule spans, which will soon be in operation. The Erie, the Boston & Maine, the Baltimore & Ohio, the Florida East Coast, the Lake Shore & Michigan Southern and the New York, New Haven & Hartford all have bridges under construction, which will be put in service sometime during the summer of 1911, and several other roads will complete important movable bridges of Strauss design during 1912. Among the new orders received by this company is an ornamental bascule span for the double deck concrete viaduct of the Boston Elevated Railway.

C. S. Davis, formerly chief engineer of the Toledo-Massillon Bridge Company, and vice-president and manager of the Massillon Bridge & Structural Company, has severed his connection with those companies to take charge of the business of the Strauss Bascule Bridge Company in eastern territory. Phil L. Kaufman is in charge of the business on the western coast, John Irving and C. H. Sutherland are Canadian representatives, and K. Hajgaard is European agent for the company. With this representation the company confidently expects large increases in its business. Models of the bascule type bridge are on exhibit in booth 160 at the Coliseum.

GAS ENGINE AND GENERATOR OUTFIT.

An interesting feature of the Fairbanks, Morse & Co. exhibit at the Coliseum, is one of their 9-horse-power gas engines, direct-connected to a 5½-kilowatt generator which is furnishing current for the additional lighting which is being used in their space. This company has so developed its electrical business "in synchronism," so to speak, with its engine business, that they are now producing electric outfits driven by belt or direct connection from internal combustion engines, and these outfits are being used generally by railways not only for lighting, but for charging storage batteries for operating signals and drawbridges.



Fairbanks-Morse Gasoline Engine Direct Connected to Generator.

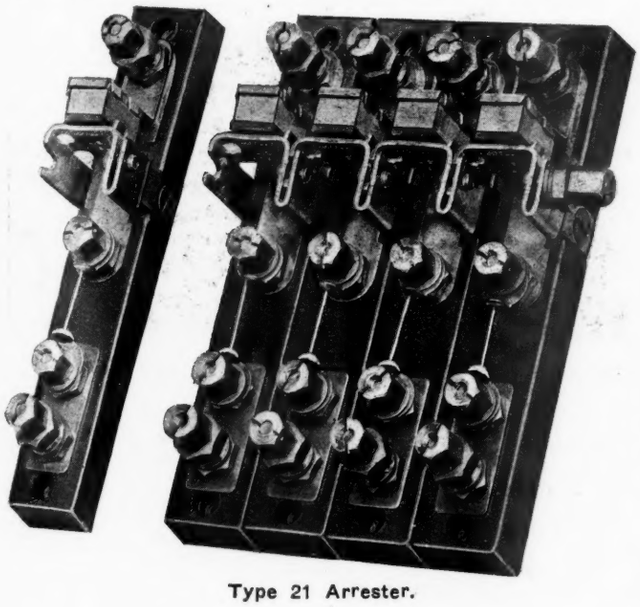
The engine in the generating outfit now on exhibition is known as a special electric engine, being fitted with a special governor that gives a very close regulation, which is necessary in the production of electric current, especially for electric lighting. This machine has been developed from the ordinary "hit and miss" type of engine and the regulation is as close as can be obtained by steam or other power. This special electric direct-connected outfit is made in sizes from 2 to 150-horse-power, in vertical and horizontal machines and is designed to operate on gasoline, gas, kerosene, crude oil, distillate, alcohol, or producer gas.

In connection with isolated plant work, this company has recently issued a bulletin entitled, "Catechism on Direct Current Apparatus," which has been much in demand, and a

large number of copies have already been distributed on application of engineers and other railway officers. This company makes a feature of co-operating with the railways for the development of products to meet their special requirements.

BRACH ARRESTERS.

The L. S. Brach Supply Company, New York, has recently introduced an enclosed type of lightning arrester. This new arrester consists of an insulating shell of special



Type 21 Arrester.

moulded metal made in bell shape. A recess is provided inside to accommodate the operating parts. Means of access to these parts is secured through a threaded plug

Type 23 Arrester.

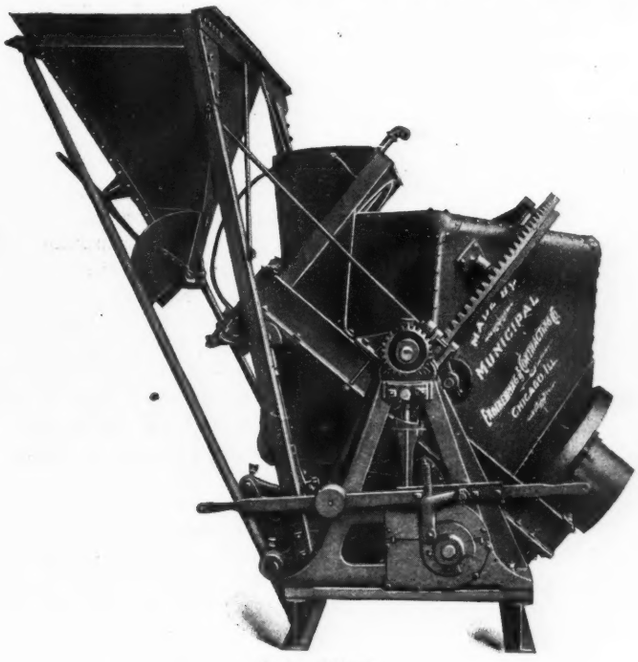
which screws into the bottom of the bell-shaped insulator. Every precaution has been taken to protect all the parts from moisture. Line terminals are moulded in the shell, and the ground terminal attached to the screw plug is protected by a double petticoat flange, which is in harmony with the best electrical engineering practice.

Among the interesting features in connection with this instrument is the fact that it may be either hung to the wire or clamped to the cross-arm, pole or building. A length of wire for making connections enters the top and bottom of this arrester, so that a splicing connection may be made. Another type of the same instrument is provided with a Fahnstock clip for easy and rapid installation. As the Brach arrester cannot become grounded, it can be seen that this type may be put anywhere on the circuit without providing for inspection. Vents of special design in this arrester take care of the accumulation of gases by heavy discharge.

This arrester is being shown at the Coliseum this week and is also illustrated in the L. S. Brach Supply Company's catalogue No. 2, which was recently issued.

CUBE MIXER.

The first form of machine to be extensively used for mixing concrete was a cubical box journaled at diagonally opposite corners and having a door in one side through which the charge of cement, sand, stone and water was filled and the batch of mixed concrete was emptied. While this old, home-made machine was slow of operation, it turned out a concrete so uniformly mixed that no hand-mixed product could compare with it. This same idea of cube has been retained in the Chicago improved cube mixers, made by the Municipal Engineering & Contracting



Cube Mixer.

Company, Chicago. In these mixers there are no scoops, paddles or shelves, but the batch is treated as a unit, being shifted six times in each revolution and given a criss-cross motion. The material is constantly folded over on itself, is having its shape continuously changed and is under constant squeezing and pressure. In this way, as the entire batch is always in motion, each particle is constantly rubbing against some other particle as the mass is folded and refolded on itself, and there is a great crushing, grinding and kneading of the ingredients, every pebble or piece of stone being perfectly smeared with the coating of cement paste.

ROCKFORD GASOLINE MOTOR CAR.

The control and manufacture of the Rockford motor car, originally introduced by the Duntley Manufacturing Company, Chicago, have been acquired by the Chicago Pneumatic Tool Company, Chicago. This company has bought all patterns, patents, goodwill, etc., and made the necessary arrangements for making the cars, and for supplying repair parts. During the two years the Rockford car has been in service, it has shown its advantages in the saving of time and energy, the longer hours of work possible and better condition of the men when at work, and in other ways. Many voluntary letters from the practical men in charge have been written commending the service of these cars under widely varying conditions. The frame construction is of welded steel channels and angles, insuring stability and durability. The power is a two-cylinder, four-cycle engine, direct connected to the driving axle, developing 3½ to 15 h. p., according to style and intended service. The control is so arranged that the speed can be easily regulated.

These motor cars are built in several styles, for regular service in maintenance of way, for inspection purposes, and for extra heavy service, bridge, telegraph and signal work. All these cars are built to pass switches and curves with certainty of staying on the rail, but are easily and quickly removed from the track.

COAL WASHING PLANTS.

Coal washeries are built to remove from screenings as mined impurities, such as sulphur, slate, fire-clay or other substances foreign to the coal itself, by a mechanical process called "washing," and after removing the impurities to separate the washed coal into the established market sizes, such as washed egg, No. 1 washed nut, washed pea, washed slack, etc.

Fig. 1 illustrates a coal washing plant having a capacity of 900 tons per day. The screenings, including all coal 3½ in. in size and smaller, are conveyed from the tipple at the coal mine by a belt conveyor to the unwashed coal storage bin of the washer and from this bin are fed automatically into the washing machines, called "jigs," where the separation of the impurities from the coal takes place. The screenings are immersed in a receptacle containing water which is given a pulsating motion by fast moving eccentrics. This causes the impurities to separate from the coal, the heavier particles or impurities falling to the bottom of the jig and being removed therefrom separate from the coal. The coal is of a lighter specific gravity than the impurities (or refuse) and is floated off the jig at its top surface by the pulsating motion of the jig.

The washed coal on leaving the jigs is sluiced with the washing water to perforated bucket elevators and screens for the purpose of removing the water from the coal and separating the washed coal into the desired market sizes. Each size is put in a separate bin having a capacity of 75 tons, or more than enough for one railway car.

The plant shown first prepares the washed coal in seven sizes and is said to be the only washer operating on bituminous coal that is successfully making this perfect sub-division of sizes. It is just as important to size the coal properly as it is to wash it properly. The refuse is removed from the jig by perforated bucket elevators which deliver it to a small refuse car. This car is actuated by a small hoisting engine, which pulls it up a small incline to the refuse dump. The refuse material is valueless and is simply wasted over the country adjoining the plant.

The plant is provided with adequate settling tanks which permit the coal to settle from the water. The water in the tanks is allowed to overflow and is then recovered and pumped back to the jigs, providing a continuous circulation of water. This is permissible only where the nature of the impurities is such that they will not pollute the water, as happens when an excessive amount of fire-clay is mined with the coal.

Each coal washing proposition is a problem in itself, as a plant suitable for Illinois would not be suitable at all for Pennsylvania or Mexico coal. The quality of coal and the market for it must be carefully considered and the plant designed to suit.

The other picture shows a plant built for the Pittsburg-

Coal Washing Plant at Pana, Ill.; the Bituminous Coal Washing Company.

Westmoreland Coal Co. at Weaver, Pa. It is of reinforced concrete and brick construction throughout, having a washing capacity of 1,800 tons per day, and is equipped with a reinforced concrete washed coal storage bin having a capacity of 1,800 tons.

The operation of this washery is similar to that of the plant above described except that it was designed to remove from the screenings sufficient ash and sulphur to enable the company after washing this coal to make a marketable coke, which would not have been possible had the screenings not been washed. The washing of coal for coking

Coal Washing Plant at Bentleyville, Pa.; Pittsburgh-Westmoreland Coal Company.

purposes is another interesting study, and in this case it is also of the utmost importance that a careful study of the coal with its analysis be made together with the mining conditions before designing the coal washing plant.

The Roberts & Schaefer Co., Chicago, designed and built the plants described above, this being one of the specialties of that company. In addition to coal washeries, the Roberts & Schaefer Co. has departments devoted to locomotive coaling stations, complete coal mining and coal briquetting plants.